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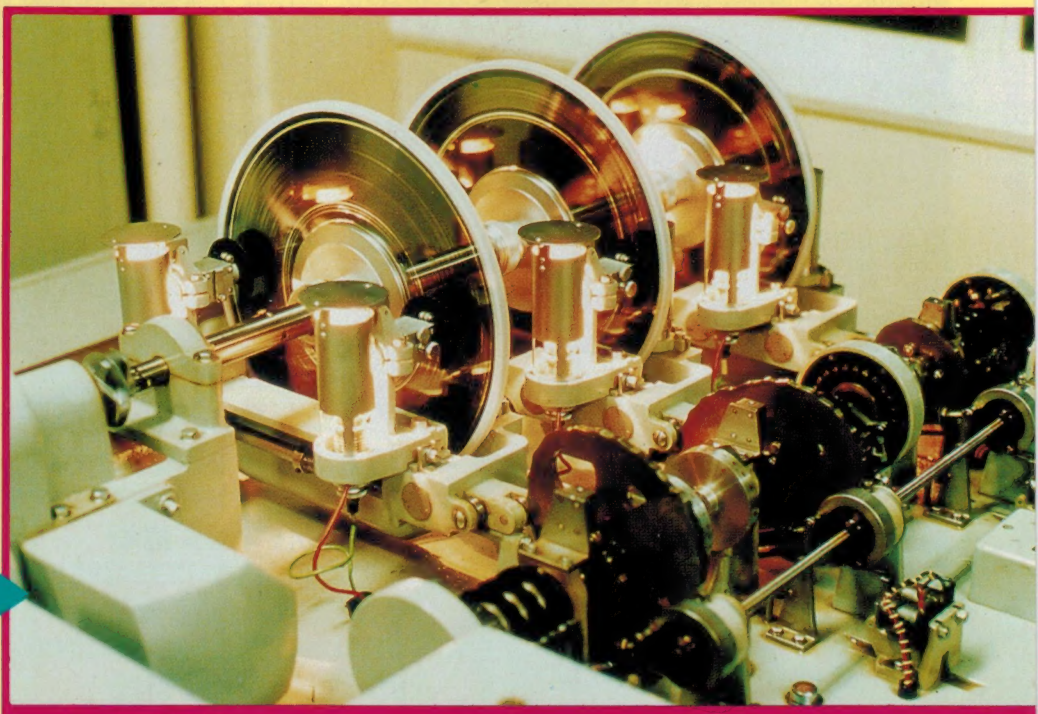
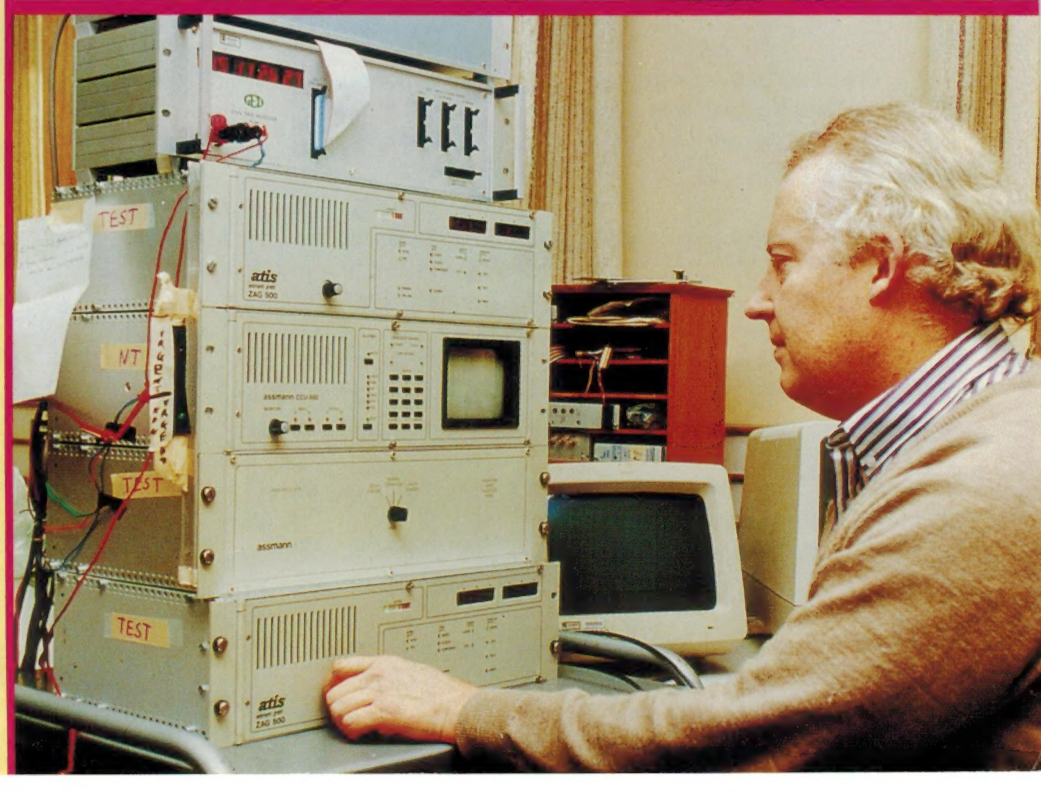
TELECOM REPLACES ITS OLD 'SPEAKING CLOCKS'



- REVIEW OF NEW LOW COST PC BACKUP POWER SUPPLIES



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ADVANCED TECHNOLOGY MADE TO MEASURE

Electronics Australia WITH eti

Volume 52, No.11

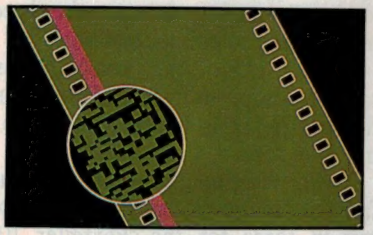
November 1990

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE – ESTABLISHED IN 1922

Breakthrough in UPS's for PC's

Now even personal computer users can have protection against blackouts, thanks to the release of a new family of really low cost UPS's. See our story starting on page 140.

New sound for the movies



Get ready for next generation of movie sound, with six channels of CD quality! Barrie Smith explains how it works, in our feature starting on page 20.

Win an Icom IC-R100!

Don't forget our competition, to win an Icom 'mighty midget' IC-R100 communications receiver. See the details, on page 18.

On the cover

It had to happen – Telecom is finally replacing its wonderful old whirling-disk and light-beam optomechanical 'Speaking Clock' with a modern digital version. Our pictures show the old and the new versions, by courtesy of the Telecom Research Laboratories. (See our story on page 40)

Entertainment Electronics

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Projects and Technical

Workstation

News and Comment

Departments

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LETTERS TO THE EDITOR

Overseas kits

Back in January this year an article was published in *EA* about electronic kitset mail order companies around the world, amongst them three companies in India. As I import electronic kitsets into New Zealand I was very interested and I wrote to all of them. They were Vishna of Bombay, Teltron and Telectron in Madras. I enclosed a 50 rupee bank draft to each to pay for postage and wrote to them in February on my company letterhead, and explained that I would like to make contact with the idea of doing business with them.

I received an answer from Vishna with a list of products, but as the listing was only one line each with very little information I wrote back and asked for more information. Also to find out how they wish to be paid and postage rates from India. That was in April; I have not heard from them since.

Telectron and Teltron have never answered me. Because the first drafts were not cashed I sent them another bank draft each in April, which according to my bank were cashed – but still no answer.

Also in the article was C&A in Athens, Greece. I also sent them a bank draft, in Greek drachmas. In April I sent them another letter which they answered saying that they had never received the bank draft. I answered that and also sent them a second bank draft, with another letter asking for their catalog. The first letter explained that they were having the catalog reprinted and would send me one when it was ready. I have not heard from them since...

The only place which gave any service was the National Institute of Amateur Radio in Hyderabad, India which immediately wrote back to me apologising that they had no kitsets for sale at the time but they sent me a number of IRCs and enrolled me in the institute for six months in return for the bank draft I sent them for postage. Because they said they were interested to see a copy of the article in *EA* I got a spare copy from *EA* and sent it to them.

At the start of July I phoned the Indian High Commission in Wellington and told them my story. The following day they phoned me back and gave me three other companies to write to which I did on July 4th. To date I have not heard back.

I buy regularly from Australian, US and English companies and have had no major difficulties to date. But I am most disappointed with the Greek and Indian companies.

Derek H. Rout,
Christchurch, NZ.

Unapproved telecomm gear

Your July issue included a review of a product known as the 'Faxteller 105'. Austel's records indicate that there is no permit in force for this equipment.

Section 114 of the Telecommunications Act 1989 provides for a penalty of up to $12,000 for knowingly or recklessly connecting non-permitted equipment to the telephone network.

Section 115 of the Act prohibits the sale of non-permitted equipment, unless the purchaser is informed that no permit is in force.

I was disappointed that your article failed to mention that there was no permit in force for the 'Faxteller 105' – anyone connecting this equipment could incur a heavy penalty.

Austel is about to launch a nationwide campaign to warn consumers of the dangers of purchasing or connecting non-permitted equipment, and that campaign would be much more effective if non-permitted equipment were not actively promoted.

Amanda Davis, Manager,
Carrier Affairs Branch, Austel,
Melbourne, Vic.

Comment: The small news item concerned was taken directly from a press release sent by the manufacturer. It's not really feasible for us to check the precise legal status of every item published in this way, unfortunately. Frankly, this seems like another rather farcical situation where it isn't illegal to make, import or advertise the items concerned – or even to sell or buy them – only to use them. Perhaps Austel should be seeking co-operation from other authorities,

rather than expecting the media to 'carry the can.'

Computer club

I represent an IBM Compatible Computer Club in the Pine Rivers Shire and would like to bring our existence to the attention of any of your readers who are interested in computing. To this end I write to request that you include an extract from the following in your 'Letters to the Editor' section.

The Pine Rivers IBM Compatible Computer Club is a relatively small club incorporated in Queensland. We are not a 'hackers' group but rather a group of enthusiastic computer users who share a mutual interest in computing and computer related technology. The people involved in our club come from varied backgrounds, with teachers, accountants, students, hobbyists, engineers and private business owners to name a few.

We produce a small interesting monthly newsletter and meet on the second Monday evening of each month. At these meetings the committee endeavours to organise and present topics which are both educational and enjoyable for our members. To cover postage and incidental costs, we have a nomination and yearly membership fee.

Persons interested in contacting us can write to The Secretary, PO Box 329, Strathpine 4500 – and we would welcome any enquiries.

Eric Comino, President,
Strathpine, QLD.

Unfair to valves?

Graeme Barber (letter August) must have been in a hurry when he read the review of the Series 500 Valve Amplifier featured in your May issue.

My copy states 'this amplifier offers truly outstanding SONIC performance' not supersonic as claimed in his letter, which I have no doubt can be supported by the specification.

The tone of your correspondents' letter suggests he may be of the 'solid state generation' and has not experienced the fascination and joy of bathing in the warm glow of thermal devices whilst listening to his favourite sonata.

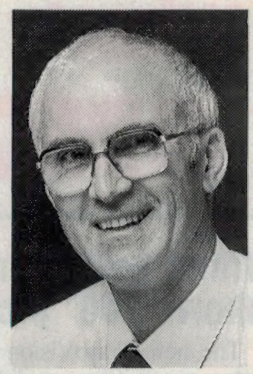
Graeme, where is the romance in your soul?

If Mr Barber has the opportunity to evaluate the amplifier in question, I believe he may be pleasantly surprised.

I have no axe to grind, having recently retired from the electronics industry, but I do like to see fair comment.

Bill Marshall,
Chatswood, NSW.

EDITORIAL VIEWPOINT



The only thing constant is change, especially in electronics...

Don't worry, I'm not proposing to make any further comments about the deregulation-cum-privatisation of Telecom/OTC/Aussat. It all looks like going ahead, anyway; I only hope that we don't end up repeating ALL of the mistakes made overseas in similar moves...

Getting back to electronics, one of the things I personally find intriguing about our chosen area of technology is the way its impact on our society is very often one of *evolution*, rather than revolution. There are certainly areas where the changes are dramatic enough to warrant the latter term, but much of the time they are more subtle than this – more a series of steady improvements, in either performance, reliability or cost effectiveness.

This is illustrated rather well by two of this month's stories – one the news item on Telecom's replacement of its old opto-mechanical 'speaking clock' with a new digital model, and the other Barrie Smith's feature article on Kodak's new digital sound system for the movies. In both cases new digital technology is being used to achieve significantly higher performance and reliability, yet neither is what you could describe as truly revolutionary.

Of course even evolutionary change can have its costs, as well as its advantages. For example with the new Cinema Digital Sound, cinema patrons will shortly find themselves regaled with six channels of CD quality sound, bringing back the kind of sonic impact that the movies used to provide. But on the other hand to provide us all with this benefit, cinema owners will have to invest in the new CDS scanning heads and decoding equipment – so that in the long run, we may find ourselves paying that little bit more for a visit to the movies.

Luckily many of the evolutionary changes brought about by new technology do *not* in themselves add to the costs; quite the contrary, in fact. This is certainly the case with IC technology, which has dramatically *lowered* the costs of many items of equipment from cassette decks to computers, while simultaneously boosting their performance.

There's another good example of this particularly welcome kind of change, in this same issue. As our review starting on page 140 reveals, the cost of adding power-failure protection for computers has now fallen to less than half its previous minimum level – bringing it finally within the reach of personal computer users.

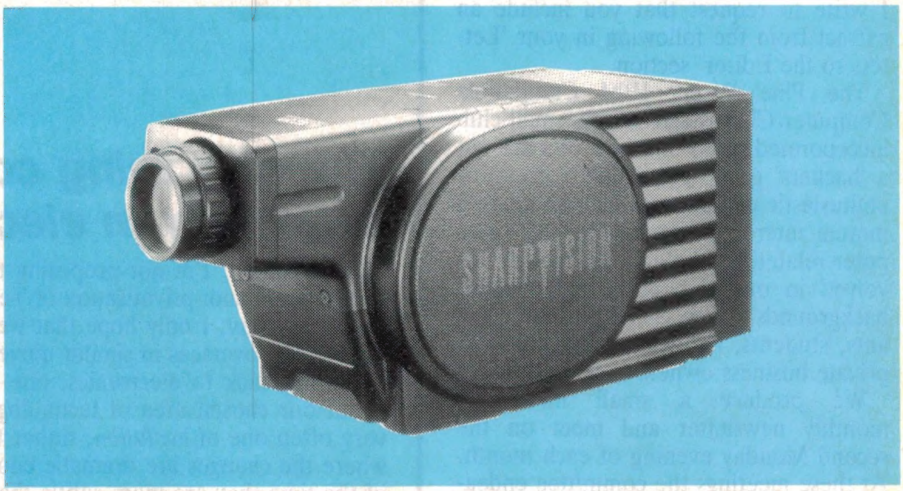
But while some of technology's changes save money and others have an implied price tag, both kinds keep on coming. Even more so in electronics than in the wider world, the only thing that tends to be constant is change. At least in electronics you have magazines like *EA* to help you understand and keep up with those changes...

Jim Rowe

PS: You'll find that the magazine too has undergone another small evolutionary change, with this month's issue. Although all of the ongoing features from *ETI* are still with us, they're now fully assimilated and part of a single integrated magazine.

What's New in VIDEO and AUDIO

Video projector shows 100″ pictures



The new SharpVision 100 LCD Projector can produce a diagonal image of up to 254cm (100″), 15 times the viewing area of a standard 63cm TV screen. By linking the projector to a video, you can therefore have TV and video pictures the size and impact of a cinema screen. Sport, news and movies all 'come to life' with greater impact.

The new twin TFT active matrix LCD projection system was developed by Sharp which is one of the world leaders in LCD technology. It is said to offer the advantage of a high quality picture in a compact and easily transportable unit.

SharpVision uses three tiny LCD panels which replace the cathode ray tubes found in conventional projectors. Each panel is dedicated to the red, green and blue spectral components and is comprised of 100,980 pixels, for a total resolution of 302,940 pixels. The result is said to be exceptional definition and clarity.

Unlike earlier projectors, the unit is compact and light enough to move from room to room, home to office, or home to holiday home, as it weighs under 14 kilos. Because of the single lens optical system, it is also much easier to set up.

The LCD projector system also has a range of versatile options such as high quality screens, Super VHS videos and a hi-fi Surround-sound-system to satisfy the most discerning audiophile.

Larger 'midi' system from Akai

Following on from the M-333 system released earlier this year, Akai has introduced the M-373 system into the hotly contested $1000 price point 'midi' market. The M-373 boasts greater power and performance, with a larger number of features including cordless remote control, 25 watt/channel CD player, stereo amplifier with five band graphic equaliser, double cassette deck, 10 pre-set digital synthesiser AM/FM tuner, auto belt driven turntable and 2-way 70 watt speakers.

The double cassette deck offers both normal and high speed dubbing and provides a convenient 'synchro' recording feature permitting exact recording from tape one to tape two by enabling both tapes to start together automatically in the record mode.

The auto turntable offers a DC servo-driven motor, for greater accuracy and stability and provides two speed belt driven operation (33 and 45rpm). The player includes a ceramic cartridge and offers tone-arm queing to allow precise location of the stylus on the record, plus automatic return when the record is finished.

The compact disc player is a 16-bit twice-over sampling digital filtering unit offering up to 16 random programme selections. The player uses three beam laser technology.

The M-373 midi system has a recommended retail price of $999 and is covered by a one year parts and labour warranty. It is available at Akai dealers and selected department stores.

Cassette deck plays six tapes

With a new six tape multi-cassette deck recently released by Pioneer Electronics Australia, the user can line up six cassettes for continuous recording or playback for up to nine hours (6 x C390 tapes). The system therefore offers similar benefits to the multi-CD players already available for car and home use.

Code named the CT-M6R, the new cassette deck will free hosts from changing cassettes at a dinner or party, and offer the opportunity of continuous recording of long broadcasts or music sources – subject to copyright laws of course!

The unit also offers CD-Deck Synchro with the latest range of Pioneer CD players, meaning that it provides the capability for recording six CDs to six cassettes at the push of one button.

With the full function infra-red remote control, the CT-M6R's owner can sit back in a comfortable armchair and take advantage of the scan facility to play a favourite track or two.

This allows a 10-second playback of one cassette after another until the chosen cassette or track is found. If the scan lands on a blank spot it will continue to search until music is found.

To top it all off, Pioneer's multi-cassette deck incorporates Dolby B and C, for maximum tape noise reduction, as well as Dolby HX-Pro designed to give superior recording quality from compact disc.

The CT-M6R Multi-cassette Deck is retailing for $699 at all specialist Pioneer hi-fi outlets.

Onkyo releases 'bit stream' CD's

Onkyo has introduced three 'bit stream' CD players, the DX-2800, DX-3800 and DX-6800, featuring a pulse width modulation (PWM) system which is claimed to offer added advantages over competitive one bit systems. Onkyo says its system has the ability to eliminate noise elements which can be generated if the timing accuracy of the D/A converter is not absolutely accurate. This is apparently achieved by use of a proprietary 'Super Quartz System', which maintains absolute stability and an extremely accurate clock oscillator.

Onkyo claims a further advantage with its use of separate D to A converters in the digital filter chips, claiming this design concept eliminates pulse noise caused by mutual interference between the two operating sections.

The DX-3800 and DX-6800 employ separate converter/filter elements for both left and right channels and Onkyo says this has allowed it to achieve an unequalled 110dB signal to noise ration. These models also use a newly designed Linear Motor Actuator disc drive, claimed to provide faster access and better pick-up precision.

The DX-6800 has a recommended retail price of $1199, the DX-3800 has a recommended retail price of $899 and the DX-2800 $699. All models are covered by a five year parts and labour warranty on the electronics and a three year warranty on the laser, and are available at Onkyo dealers.

Boundary-layer mike from Neumann

The new GFM132 Condensor Boundary-Layer Microphone is claimed to feature identical, completely flat diffuse and free-field frequency response; a frequency independent hemispherical directional pattern; and high output capability with very low inherent noise, resulting from Neumann's TLM transformerless hybrid electronics.

An innovative triangular design is a result of development and optimisation with the aid of computer simulation, and is claimed to eliminate any linear distortion in frequency response typically associated with circular, square or rectangular boundary layer microphone designs. Conventional designs display a pronounced linear distortion in their frequency response, caused by the interference of the incoming primary sound field with the secondary sound field produced by diffraction at the edges of the sound plate.

Sound pressure alternation occurs at the location of the microphone transducer which is dependent on the frequency and angle of incidence. The GFM132's triangular design is said to distribute the path lengths of the sound field from each edge point of the plate to the centre point of the transducer evenly, for all wavelengths within the microphone's operating range.

The GFM132 features fet100 series transformerless circuitry, providing high output capability with very low inherent noise and a wide dynamic range of 123dB. The microphone operates from 48 volt phantom powering and is provided with a non-slip base and facilities for all mounting.

For further information circle 182 on the reader service coupon or contact Neumann distributor Amber Technology, 5 Skyline Place, Frenchs Forest 2086; phone (02) 975 1211.

New concentric speakers from Tannoy

Tannoy has introduced a new range of speakers for the 1990's, aptly named the Series 90. There are two main groups in the new range, one of which is based on Tannoy's continuing committment to the 'Dual Concentric' principle; the second group Discrete System technology.

All designs incorporate the very latest technological advances in speaker design, including 'differential material technology' (DMT), computer aided design (CAD), computer modelling analysis and extensive anechoic chamber testing.

The Dual Concentric models are the DC1000, DC2000 and DC3000, all using an advanced 8″ (200mm) driver. The basis of the Dual Concentric driver is a bass unit with a polyolefin co-polymer flared cone, which provides a horn flare to an aluminium tweeter mounted dead centre within the throat of the driver. This design simulates a point source – the ideal criteria for perfect stereo imaging. Starting price for the Dual Concentric models is $999 for the DC1000 to $2799 for the DC3000.

The Discrete System range comprises of five models ranging from the 11 litre E11 at $499 through to the 45 litre 3-way system, the J95 at $2499. The Discrete System models all use a specially designed separate 25mm aluminium domed tweeter with heat-formed polyamide suspension. Also, as opposed to the normal practice, the kapton voicecoil former fits over the outside of the integral dome skirt.

Tannoy has included bi-wiring on all models of the Series 90, to allow individual connection to the bass and tweeter units. High quality components have been specially selected in the design of the cross-overs, including polyester capacitors, iron dust inductors and Van den Hul cable.

Tannoy pride themselves on consistency in quality control and that each monitor will have similar characteristics. To achieve this each driver is individually calibrated and documented.

Lower cost FA amplifier

Where high quality and cost effectiveness are concerns, Crest Audio says its FA Series amplifiers are the answer. Models in the FA Series use the same quality components, intelligent packaging and construction techniques found in the Professional Series. Although they are cost effective, they are by no means 'cheap amps'.

Crest has always been known for power supply design. Its well designed power supply can store and deliver the energy needed for tight and full bass response. All Crest models include extensive protection against short circuits, DC voltage, thermal overload and turn-on/off noises.

Models in the FA Series also include IGM impedance sensing gain reduction, a clip limiter and auto-ramp signal control. Completely modular construction minimises down time and associated service costs should service ever be necessary.

There are three models in the Crest FA Series. Model FA2401 delivers 580 watts into 4 ohms, Model FA1201 delivers 450 watts into 4 ohms and Model FA901 delivers 300 watts into 40 ohms.

For further information circle 183 on the reader service coupon or contact the sole Australian distributor, Entertainment Services of Australia, 703 Heatherton Road, Clayton South 3169; phone (03) 562 4605.

Yamaha brings you the most innovative entertainment technology since moving pictures...

Moving sound.

Prepare yourself for a very special audio and video experience.

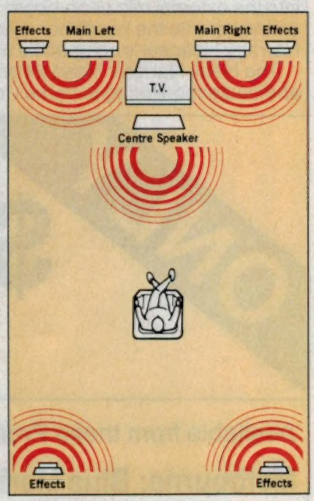
With Yamaha's innovative Digital Sound Field Processor technology, you can recreate the excitement of actual live performance venues and cinema sound, right in your own living room.

Digital Sound Field Processing precisely recreates the special ambiance of these environments, for a breathtaking listening experience.

At the touch of a button you can have the acoustic characteristics of a European concert hall, a Jazz club, an open air Rock venue, a Disco, a Church or even an Opera house.

Yamaha's exciting 'Moving Sound' system: The DSP-A700 amplifier and it's companion AVS-700 selector, centre speaker, main speakers and the smaller effects speakers.

When watching video, just select DOLBY* PRO-LOGIC SURROUND to recreate the magic of the cinema.



Multi-dimensional sound imaging created with a 7-speaker DSP-Dolby Pro Logic surround system.

For example, when a movie shows a gun being fired, you'll hear the bullet ricochet around the room. When a plane prepares to land, you'll hear it soar over you from behind and touchdown at the front of the room - that's just how life-like this system sounds! All functions are fully managed by a learning remote control which completely integrates and operates your TV, video and audio system.

To experience the excitement of 'MOVING SOUND' and to find out just how easy this system is to operate and install in your living room, see your local YAMAHA HI-FI Specialist now.

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FIVE YEAR WARRANTY

*Dolby Pro Logic Surround is a trademark of Dolby Laboratories

READER INFO No. 2

NADY SYSTEMS INC. Video Camera and Camcorder Innovations

Nady VCM-100
Video Camera Boom Microphone

$99.95

- Solves the problem of poor quality sound in your videos by replacing the on-board mic supplied with your camera. On-board mics have limited capability and usefulness in most video applications.
- Highly sensitive super-directional microphone gives you professional quality audio in all your videos. Switchable for normal or long distance.
- In long distances mode the Nady Boom mic eliminates extraneous noise, and picks up only what you want to record. Ideal for lectures, contcerts, weddings, parties, or nature recordings.
- Super cardiod electrol condenser element gives wide frequency response with extremely low noise.
- Powered by on AA battery.
- Includes Microphone, 3 foot Coil Cord and Shoe Bracket for on-camera mount, 20 foot Cord for remote use, and a full length Foam Windscreen.

Nady NHM-200
Narrator for Headset
for Video Cameras & Camcorders

$39.95

- Add voice-over narration while shooting a video.
- Monitor the audio your camera is recording.
- Lightweight and comfortable wear. Easy to hook up and use.
- Works with all video cameras and camcorders.

The Nady Narriator Headset lets you record voice-over narration on your videos while shooting. You can also use the NMI 200 to monitor the audio being recorded, whether from the headset mic, an on-board or attached mic, of a wireless microphone system used with the camera.

The NHM-200 is a lightweight headphone/boom mic combination that's comfortable to wear and easy to hook up. To use both narration and monitoring capabilities, plug the headphone connector into the camera's headphone jack, and the mic connector into the external mic or on-board mic jack. To monitor only, plug the headphone connector into the headphone jack, and use the on-board or external mic for audio. The Narrator Headset is compatible with all video cameras and camcorders have these jacks.

The Nady Narrator Headset brings the professional features of voice-over narration and audio monitoring to home video camcorder use.

ONLY $89.95

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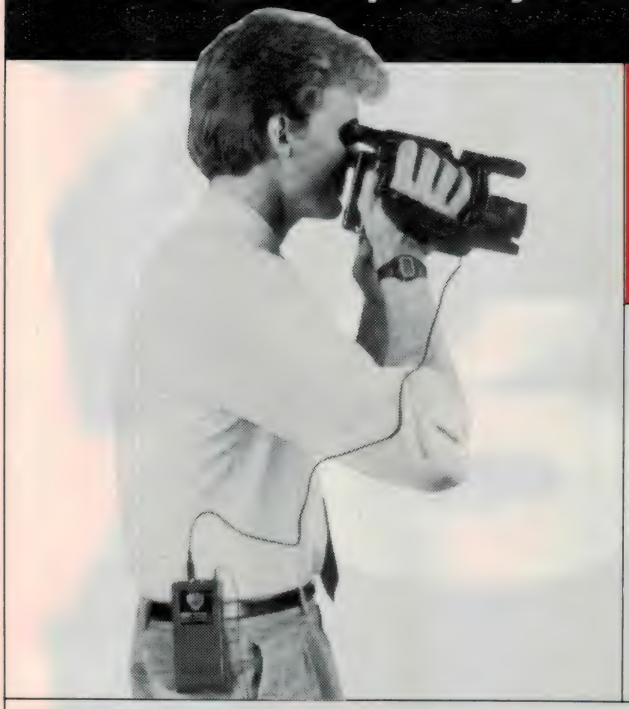
NADY 151 VR

Wireless Microphone System for Video Cameras and Camcorders



- Puts the microphone "where the action is" for professional quality audio on your tapes
- The NADY I5IVR Wireless System will make an amazing difference in your vidoes.
- Range is 200ft.
- Works with all video cameras and camcorders having an audio input.

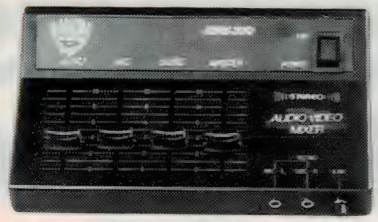
$399.95

$399.95

NADY'S AVM-300 VIDEO MIXER

$99.95

- Four channel audio input with separate gain control and full mixing capability.
- Economically designed control board for ease of use.
- Dynamic microphone for high-quality voice recording.
- Compatible with all camcorder makes.



Nady's AVM-300 Video Mixer brings music and narration to camcorder videos with a design that emphasizes ease of use and compatibility with a range of audio and video components.

The AVM-300 accepts up to four channels of input with a separate gain control to for each. This allows users to combine music and narration, or fade in and out of different pieces of music with ease.

The Mixer's master gain knob controls the volume level of the finished product, and a dynamic microphone that's highly effective for both voice and music tracks completes the fully integrated package.

The mixer feeds from a camcorder's audio output, along with its own microphone and up to two other audio sources. All of these sources plug into the back of the compact, ecoonmically designed unit. After hooking up the audio, the user then plugs the camcorder and mixer into a VCR and adds sound while viewing the video on-screen.

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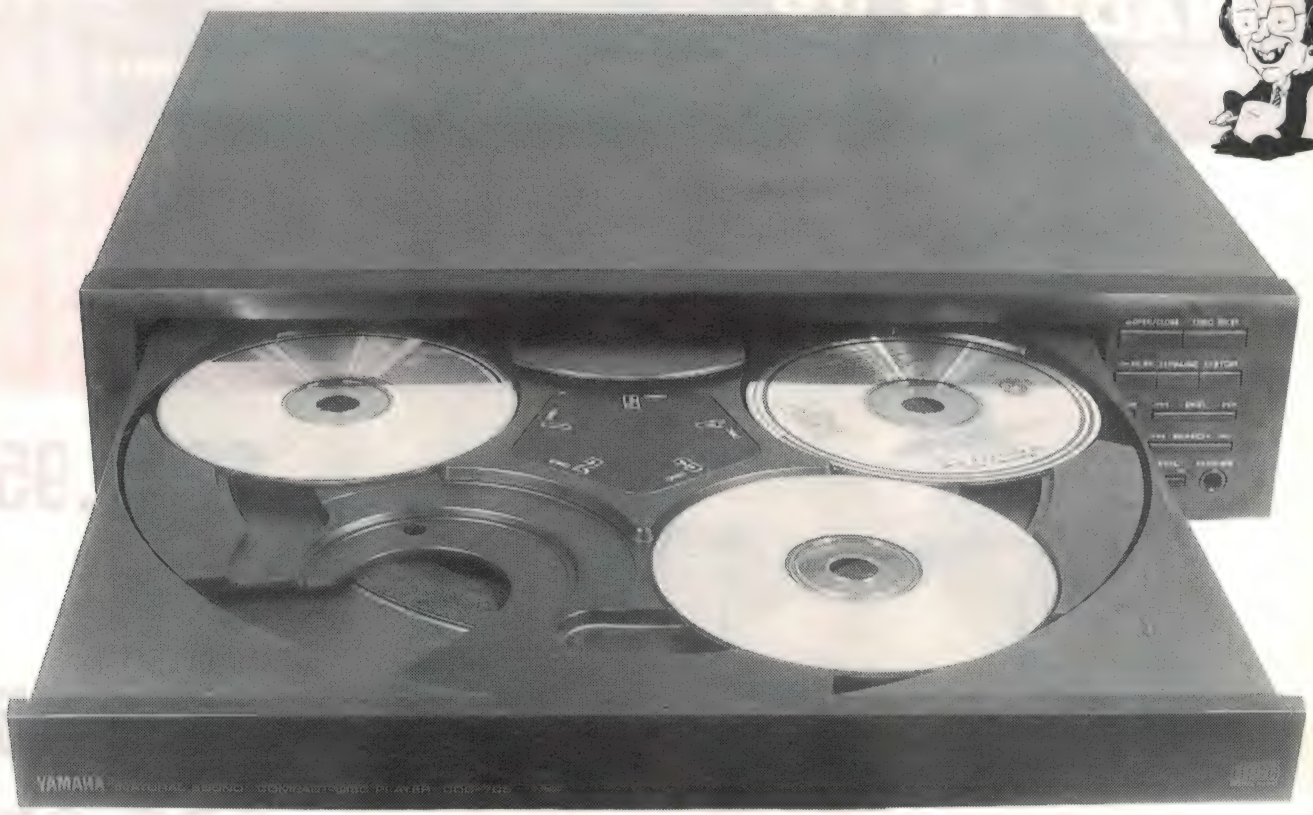


MUSIC, MUSIC, MUSIC: YAMAHA'S CD CAROUSEL

This month, Louis has been testing and listening to Yamaha's new CDC-705 'Multi Music' five disc CD changer – which also appears to be the firm's first CD player using the new '1 bit' technology. He found it a very interesting and impressive unit...

The public's perception of what it wants is all too often motivated by slick marketing of a product – to the point where the buyer really does believe that 'this product' or 'that product' was created to meet his or her requirements. Nowhere has that belief been more delightfully, if not surrepticiously advanced than it has with the new CDC-705 Yamaha 'Multi Music' CD changer which hit my desk last month.

Now the concept of CD changers was a novel thought from the Pioneer camp, although Yamaha's approach to the concept is refreshingly innovative. And frankly it is slick! Their approach is totally different to the Pioneer concept and it is both neat and most impressive.

The Yamaha 'multi music CD changer' is based on two sets of technological advances combined into one economical and attractive package. But then I really am jumping the gun, to praise something before I've even described what it is.

The CDC-705 is a five disc CD player with a rotating carousel tray, onto which you can load four fresh discs whilst the fifth disc is being played. This concept may not immediately appear to be an optimum ergonomic solution, but it is an eminently practical one. It proves itself as soon as you load up an opera with two, three or more discs, and decide you want the music to keep on rolling.

The second exciting feature of the CDC-705 is that this appears to be the first release of Yamaha's long awaited '1 bit' technology. Of course, Yamaha do not call it that. Like all their competitors, they've invented their own name for it; in this case they call it 'S Bit' technology.

The 'S Bit' technology is apparently based on '18 bit' digital technology, 32 times over sampling (as are most of their competitors '1 bit' players), third order noise shapers and pulse width modulation digital to analog converters.

The innovation doesn't end there, and the way in which the rotating carousel handles the discs is cleverly contrived to get the best out of the system – but of course to really see how this CD changer works, you have to take the cover off and then its innermost secrets are bared for all to see.

The CDC-705 is large. In fact it's so large that when I unpacked it, I immediately thought I had received a production version Yamaha Videodisc player, as I had seen the prototype in Hamamatzu two years ago. But no! I was wrong. I didn't actually realise my mistake until I plugged the player into the mains and pressed the 'OPEN/CLOSE' button on the front panel. The tray then popped out and I instantly apologised for having been so rash in my suppositions.

With the tray out, I was able to see that the 'Multi Music Player' accepts four standard size or single play CD discs, and is so easy to load, that once done (with standard size discs of course), you don't have to come back for hours.

The front panel is plain (black) in this case, with titanium finish available at the same price. The lettering is neat but not clear enough – in poor light it is not easy to read the letters.

On the right hand side of the front panel is a large mains power switch. Alongside this is the simple plasma display, which shows which of the discs is being played, with neat boxed-in numbers and advancing boxes with arrows on one side. It also displays the track being played on the disc, together with the remaining time in minutes and seconds for that disc, or the total remaining time, or the remaining time on that track, or the time played on that track. The display configuration is simply altered by pressing the 'TIME' button next to the display. The disc to be played is selected by pressing one of the five numbered buttons (1-5) in the top row of switches.

The track to be played is selected directly from the buttons numbered 1 to 9, or higher track numbers, by pushing the '+10' button, plus the appropriate 1 to 9 button. If track 22 is required, then you would press the '+10' button twice, before pressing the 2 button.

The other controls provided on the front panel are the standard array of functional controls, together with a 'MODE' switch which allows you to select a 'SINGLE' disc or 'ALL' discs. A 'DISC SKIP' button allows you to reject the current disc and advance to the next disc, whilst the 'RANDOM' button sets the changer into a cycle of play in which the discs and their contents are played in a truly random manner. the 'PROG'ram button allows you to

Measured Performance of Yamaha CDC-705 Compact Disc Player
Model No CDC-705/Serial No MO 17880 SU

1. **Frequency Response** 20Hz to 20kHz +/–0.1dB; 5Hz to 22.05kHz +0.1dB/–3dB

2. **Linearity @ 1kHz**

Nominal Level	Left Output	Right Output
0dB	0.0	0.0
–1.0	–1.0	–1.0
–3.0	–3.0	–3.0
–6.0	–6.0	–6.0
–10.0	–10.0	–10.0
–20.0	–20.0	–20.0
–30.0	–30.0	–30.0
–40.0	–40.0	–40.0
–50.0	–50.0	–50.0
–60.0	–60.0	–60.0
–70.0	–70.0	–70.1
–80.0	–80.2	–80.3
–90.0	–89.5	–89.6

3. **Channel Separation**

Frequency	Right into Left dB	Left into Right dB
100Hz	79	79
1kHz	78.5	78.8
10kHz	69.0	67.4
20kHz	63.0	61.4

4. **Distortion**

	Level	2nd	3rd	4th	5th	THD%
@ 1kHz	0	102.5	110.5	121.6	117.9	0.0023
	– 1.0	104.0	118.7	120.3	123.2	0.0019
	– 3.0	105.9	125.0	118.0	127.1	0.0015
	– 6.0	112.0	-	-	113.6	0.0008
	–10	116.8	117.1	116.9	116.9	0.0006
	–20	112.7	114.5	109.2	116.0	0.0009
	–30	-	97.2	102.4	93.1	0.0042
	–40	-	88.6	85.7	96.0	0.011
	–50	83.8	70.2	-	73.8	0.04
	–60	72.9	63.4	69.4	63.3	0.18
	–70	63.1	54.3	58.2	46.0	0.84
	–80	42.7	32.4	49.4	31.1	3.8
	–90	30.5	30.8	33.3	15.4	17.6
@ 100Hz	0	98.3	100.2	-	14.0	0.0037
	–20	107.0	110.6	106.9	-	0.0016
	–40	93.0	78.6	-	80.9	0.026
	–60	-	65.5	-	68.2	0.011
@ 6.3kHz	0	95.0	89.4	99.0		0.0085

5. **Emphasis**

Frequency	Recorded	Output Level(L)	Output Level(R)
1kHz	–0.37dB	–0.5	–0.5
5kHz	–4.53dB	–4.2	–4.3
16kHz	–9.04dB	–9.3	–9.4

6. **Signal to noise ratio**

Without emphasis	101.5(Lin)	109dB(A)
With emphasis	104.0(Lin)	112dB(A)

7. **Frequency accuracy** (19,999kHz) –1Hz for 20kHz test signal

8. **Square wave response** (See attached photo)

9. **Impulse test** (See attached photo)

10. **Dirty record test – using Philips NR4A (410-056-2)**

Interruption in information layer	400 micrometer:	Passed
	500 micrometer:	Passed
	600 micrometer:	Passed
	700 micrometer:	Passed
	800 micrometer:	Passed
	900 micrometer:	Passed
Black dot at read out side	2600 micrometer:	Passed
Black stripe test		Passed
Output impedance	Headphone amplifier	123 ohms

Yamaha CDC-705

program which disc, and which tracks on those discs (or single disc) you wish to be played.

Last but not least, the output volume control and headphone volume control is provided by means of a 'DOWN', 'UP' toggle bar, which is most sensibly supplemented by a visual segmented bar-graph on the display panel. At the extreme right hand corner of the front panel is a standard 'tip-ring and sleeve' 6.5mm headphone jack. The back panel is relatively bare, with a single pair of RCA coaxial sockets and a two core mains lead.

After you take off the lid to look inside the CD changer you find a solid slide-out plastic carousel tray, below which a large printed circuit motherboard is securely mounted. The circuitry is obviously neat, but what immediately caught my eye was the cleverly designed gear-driven CD drive mechanism, as well as an ingenious floating disc support system, which provides effective vibration decoupling of the play/exchange mechanism. This component is an essential feature for a system that must resist the repeated bumps and bangs generated by the cyclical operation of the carousel tray, while the loaded disc is still being played.

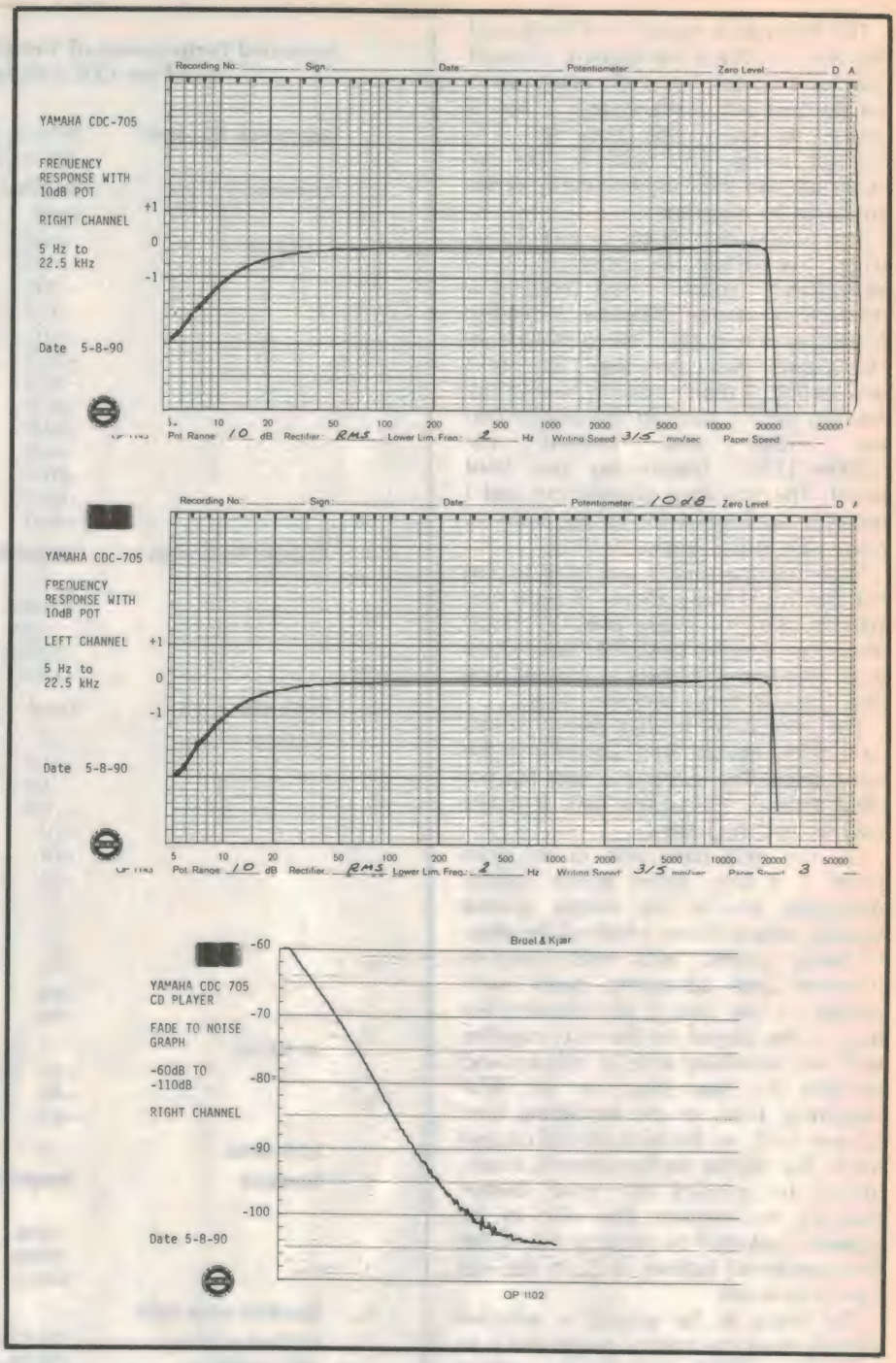
Measurements

After replacing the lid on the cabinet, I put the CD changer through its 'performance' paces to see just how well the new 'S Bit' circuitry performs and to discover how well the glossy marketing claims are achieved.

The frequency response proved to be excellent, being within +/–0.1dB between 20Hz and 20kHz. However below 20Hz the frequency response drops off fairly rapidly and is down by a full 3dB at 5Hz. This low frequency drop also shows up clearly in the 100Hz square wave response, which also drops noticeably and as expected.

The all important digital to analog conversion linearity is excellent all the way down to –70dB, and is still good at –80dB. By the time the signal levels get down to –90dB the linearity error is still only 0.5dB, which is still well above average and very commendable.

An examination of the fade-to-noise graph confirms that, although the non-linearity is still detectable between –80dB and –90dB, its maximum error occurs in the –90dB region, which means that it is doubtful that any music that you'll ever play will be modified so as to affect the audibility or quality of your signals.



Three graphs showing important performance aspects of the Yamaha CDC-705 five-disc CD player. The response of both channels was well within +/–0.1dB from 20Hz to 20kHz, while linearity was good to below –80dB.

One set of measurement figures which did surprise me however, were the channel separation figures. These provided the lowest figures (or conversely the highest feed through) of any CD player I've tested in 10 years of CD evaluation.

Although these values range between –61dB and –70dB and would not necessarily degrade the quality of listening, they are still in the order of 20dB poorer than most of the competing product figures.

By contrast, the measured harmonic distortion figures are excellent all the way down to –70dB, and the low level signal distortions are a fact of life, which is part of the 'nature of the animal' when it comes to 16 bit theoretical technology.

The signal to noise ratio performance of the CDC-705 is more than adequate at 109dB(A) without emphasis, and 112dB(A) with emphasis applied. By the same token the speed error of –1Hz at 20kHz is good and on par with most of the top line CD players.

Before you open the tray, the CDC-705 looks as if it might well be capable of playing 12" laserdiscs. The player allows any or all of the four non-playing discs to be changed, while the fifth is playing...

When I got to the impulse test, I was a trifle taken back, for this was the first time in five years that I saw a decidedly asymmetric impulse response. This indicates that the DAC circuit linearity has not been properly balanced or aligned, and that Yamaha may not have tied all the loose ends together.

By contrast CDC-705's ability to cope with dirty discs and discs with unacceptably high bulk error rates is quite outstanding.

Using my new Sony/CBS test disc, I found that the changer can happily track 2.6mm stripes (albeit even if a little chirpily). Some well known and as I have discovered, many far more expensive CD players are just incapable of tracking such major signal defects.

Taken over all, the CDC-705 displays excellent performance in terms of the most critical parameters, and outstanding performance in one area where its competitors have not yet applied the same level of sophistication.

Listening tests

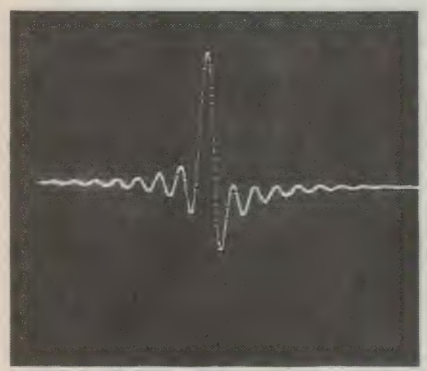
Notwithstanding the objective measured performance figures, the area of sophistication that matters to most intending users is functionality, as well as sound reproduction.

For once I had the right software at my fingertips, with a three disc set of Mussorgsky's opera *Khovanshchina* with the wonderful Russian Opera (Sony Classical S3K45831), ready to load up with two outstanding Australian discs from ABC classics – Rita Hunter singing a series of some of the most beautiful arias from famous operas (ABC Classics 426804-2) and Ronald Dowd singing Schuberts *Winterreise* (ABC Classics 426991-2).

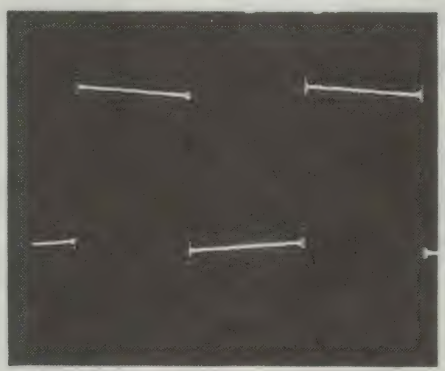
It is only when you want to play a series of discs with the music flowing continuously without the need to hop up and change those discs, that you realise just how attractive a five disc changer really is.

When I started playing *Khovanshchina*, I was also able to exercise full control over the playback volume with the Yamaha remote control transmitter, and so my most common gripe (in terms of needing to get up to adjust playback level) was appropriately resolved.

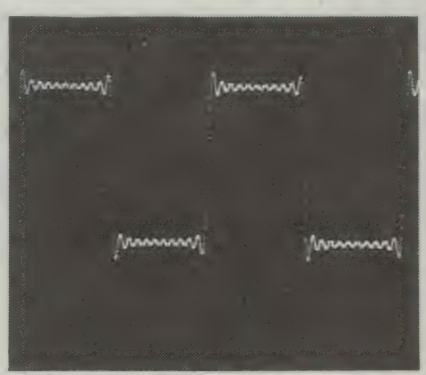
Measured Performance of Yamaha CDC-705 Compact Disc Player



Impulse response



100Hz Square wave



1kHz Square wave

Yamaha CDC-705

Mussorgsky's music is haunting although not as well known, nor necessarily as well respected, as some of his illustrious Russian compatriots. This is still an outstanding opera and this is a superbly recorded and produced rendition of it.

Nearly three hours later, after enjoying Sony's new '20 bit' recording technology, I was ready for a change of tempo and Rita Hunter's fine voice and excellent backing from the Tasmanian Symphony Orchestra provided me with some of the most wonderful and poignant arias which I have heard at the Opera over the last 30 years. My favourite is 'Un bel di Vedremo' from *Madame Butterfly* and I was truly entranced. This is an excellent example of Australian musicians and first class recording technology.

Having heard Schuberts *Winterreise* at the Opera House last year in what I considered to be a rather disappointing rendition, I was literally ill-prepared for how wonderful this song cycle projects when it is correctly recorded, with the appropriate microphone recording balance and backed by a piano which doesn't swamp the tenor's voice. This particular rendition of the *Winterreise* is an outstanding disc and Ronald Dowd is truly at his best. Thoroughly satisfied after five hours of continuous and uninterrupted music, I acknowledge that I happily went to bed.

As I was drifting off to sleep, I came to this conclusion. If you are a serious music lover and you don't really want to play around with your discs every hour, or if you have frequent parties, dinner parties or just happen to run a small restaurant, or a club, or a hotel, then the Yamaha CDC-705 is outstanding value for money. At a $499 recommended retail price, it would prove pretty hard to beat.

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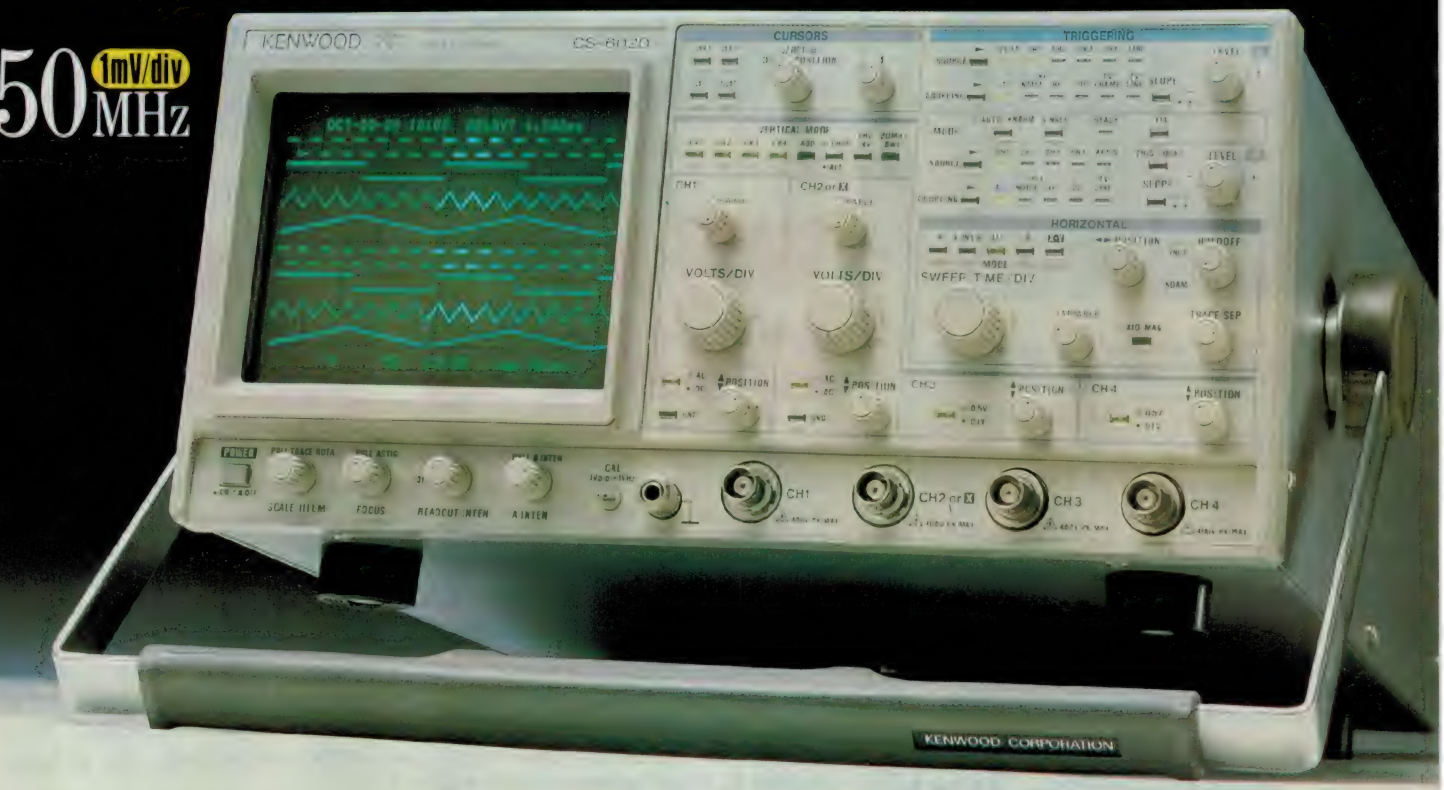

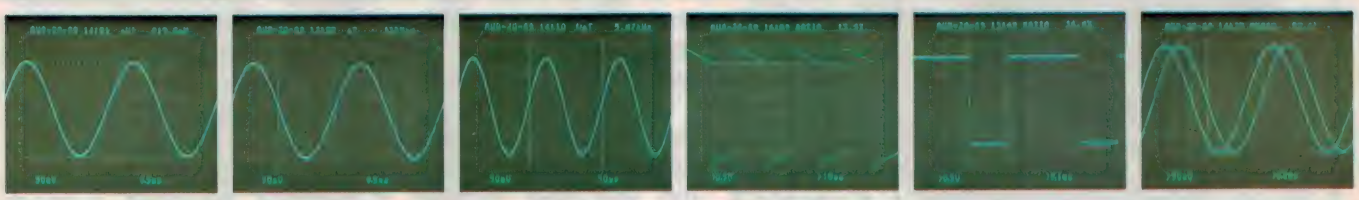

- Voltage Measurement
- Time Measurement
- Frequency Measurement
- Voltage Ratio Measurement
- Time Ratio Measurement
- Phase Measurement

The CS-6020 has CRT readout functions which provide digital indications of settings such as vertical-axis sensitivity and sweep time on the same screen as the observed waveform, as well as cursor functions which enable digital measurements such as voltage, time, frequency, and phase of displayed waveforms. This makes the CS-6020 a 150-MHz, 4-channel, oscilloscope usable by virtually anyone for waveform measurements and observation. It also has a wide range of advanced features such as trigger counting, cross-range variable, and B sweep variable, and virtually all functions are logic-controlled to ensure excellent reliability and flexibility.

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If you're keen to lay your own hands on one of these mouth-watering little beauties, here's your chance to get one for NOTHING – or at least, very little. Those nice people at Icom Australia have generously donated one shiny new R100, to be won by a lucky reader of *Electronics Australia with ETI*.

All you have to do, to enter our 'Win an Icom IC-R100 Competition' is send in an amusing little story (preferably true!) – in 250 words or less – about ANTENNAS. Transmitting antennas, receiving antennas, weird antennas, masts and guy wires, feeder cables or whatever – we don't mind, as long as it's got something to do with radio antennas. How you slid off the roof and into the fishpond when you were putting up an antenna; how your antenna fell down during a storm and you only realised it because reception suddenly improved; how you used the rotary clothesline as an emergency antenna on 52MHz and it worked better than your big beam, and so on. Get the idea?

Just keep it short and light-hearted. The story judged to be best written and most amusing will not only win its writer the Icom IC-R100 receiver, but will also be published in *EA* to give everyone a good laugh. In fact we might even publish some of the runners-up, if they're good, and pay their writers a suitable fee as a consolation prize.

Entries close on November 30, to give us time to choose a winner and get the IC-R100 to them as a nice Christmas present. So start those fingers flailing on your typewriter or word processor, or get cracking with the pen and paper!

Send your entries to 'Win an Icom IC-R100 Competition', Electronics Australia with ETI, PO Box 199, Alexandria 2015. The winner will be announced in our February 1991 issue.

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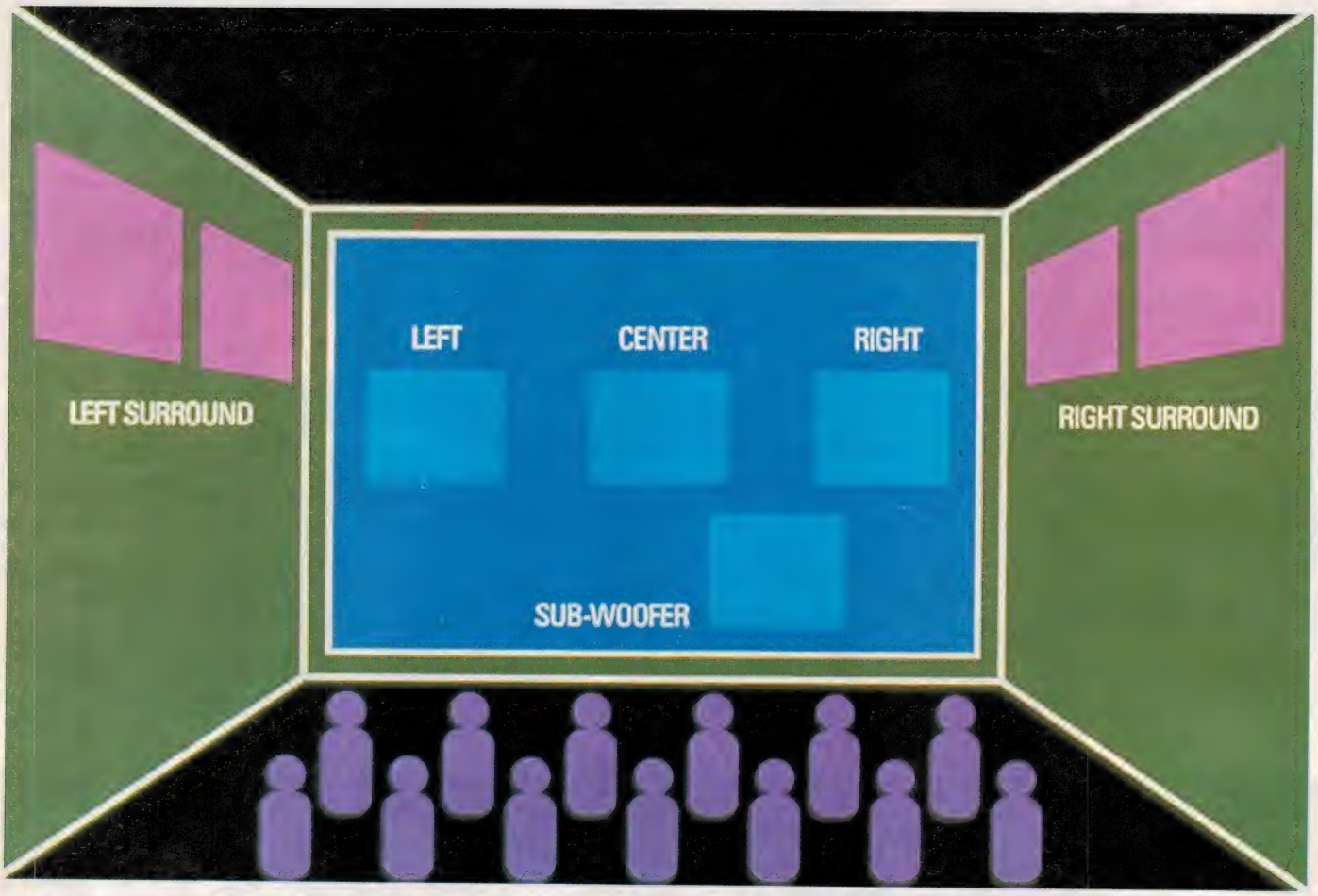
"Wait a minute – You ain't heard nothin' yet!"



Picture courtesy of Eastman Kodak Australia)

Kodak's new Cinema Digital Sound

Not so long ago, one of the prime attractions of a night at the movies was enjoying a level of sound reproduction far better than you could achieve at home – even with a 'hifi' system of the day. With the advent of CD's and Dolby noise reduction, the tables were turned; but now the cinema is about to regain the lead again. A new system developed by Eastman Kodak and Optical Radiation Corp provides five full bandwidth audio channels plus a sub-woofer channel – all with digital CD quality.

by BARRIE SMITH

Even before the 'talkies', movies were never really silent; there was always an accompaniment – by a piano, an orchestra and frequently, barrages of sound effects.

From the beginnings of the cinema in 1895, Edison had always envisaged the moving picture as an adjunct to the phonograph. *Don Juan*, a Warner Brothers film, is recognised as the first sound feature film – in 1926. But the film carried only music, and no dialogue.

It was left to Al Jolson in Warner's *The Jazz Singer* (1927) to capture the public's imagination by singing the song Dirty Hands, Dirty Faces, and adding as a spoken adlib: "Wait a minute, wait a minute, you ain't heard nothin' yet". Talking, singing sound in the cinema was a reality. But the talking and singing was produced with the aid of 16" shellac discs.

Optical sound, photographically printed onto the film in perfect sync, became a well-established reality by 1932-3. And since then, the industry has constantly refined the process by embracing magnetic and laser technology in an attempt to create a heightened sense of aural realism.

In some notable cases, the sound has been shelved off to separate, synchronous, high range playback units – giving audiences high fidelity, stereo and multi-track audio. The large screen IMAX process employs separate magnetic film reproducers, whilst another big picture format, Showscan uses banks of CD players.

But until now, the perfect answer to ultimate sound quality in the cinema has not been delivered.

Possibly, it needed the bench-mark of CD sound to be established, for research workers to know what the 'ultimate' should be. And, then again, maybe audience expectations of noise-free, distortion-free sound, with an enormous dynamic range – just like the CD player at home – were the triggers needed for the 1990 answer to a 95-year wait!

The next step

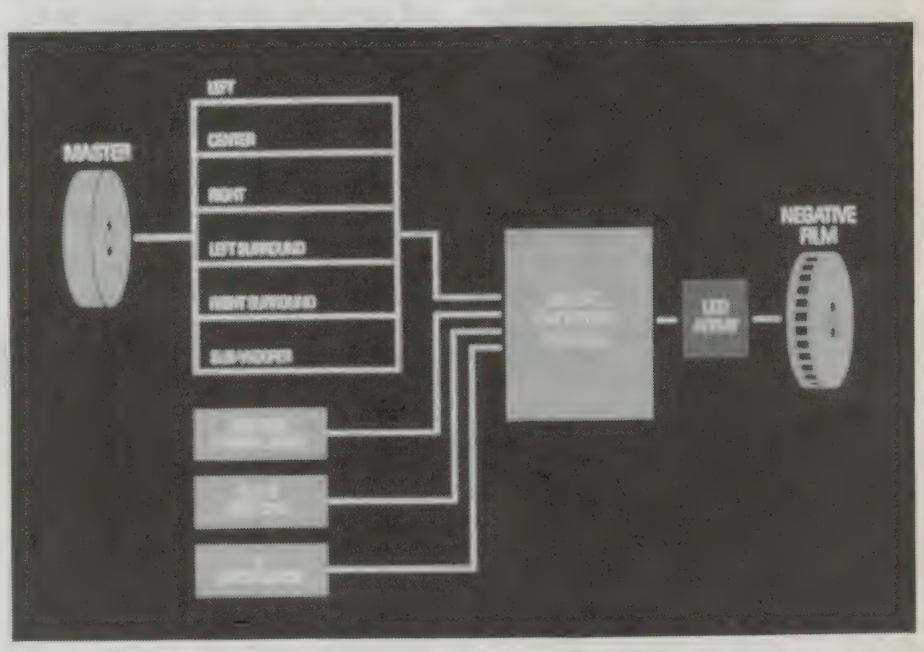
In May this year, in Hollywood, a new system was demonstrated that will irrevocably change audience perception of how audio should 'sound' in the cinema: Cinema Digital Sound.

CDS is a joint venture between Eastman Kodak and Optical Radiation Corp (ORC). Kodak will provide the digital sound film, and ORC is to produce and distribute the equipment for the system.

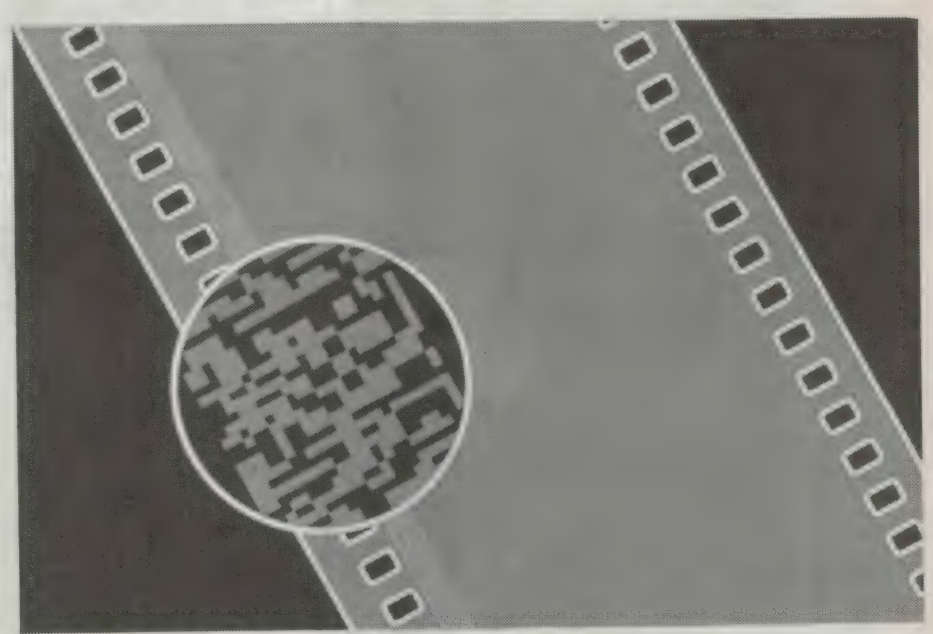
Basically the system delivers five discrete, full bandwidth audio channels, plus a sub-woofer channel. In the theatre, the full-range channels are assigned to left, right and centre speakers – all of these, plus a sub-woofer, are placed behind the screen. Additionally, two channels of surround sound are supplied to speakers at the left and right of the theatre itself.

Current 35mm analog stereo systems offer only two channels, into which four tracks are matrixed. Crosstalk effects are a significant problem with this arrangement. CDS, however, has all six channels completely separated. The result is true, unblemished stereo.

In addition to the six audio channels, there are also three streams of digital data: a control track that emits MIDI data; a track containing SMPTE time code, allowing each frame of the film to be addressed individually; and a channel



The encoding process: six discrete audio tracks and three data channels are fed into the CDS encoder, then photographically exposed onto a special sound negative. (Courtesy Eastman Kodak Australia)



A diagram of the CDS digital sound track, as printed on the film. With a data rate of 5 megabits per second, it calls for high resolution. (Courtesy Eastman Kodak Australia).

for ID information, specific to the film.

This entire highway of digital information is printed optically on the film, in the area currently used for the analog sound track.

The digital track can be produced from analog or digital masters. To create it the audio and digital data tracks are fed into a digital encoding processor. This is the heart of the system, as it combines the data, separates it into blocks, 'shuffles' it, and adds error detection and correction symbols.

This encoded data is then recorded onto film, using an LED array as the light source in the printing exposure.

The film itself – a specially developed, high resolution, digital sound recording film – was specially developed for the purpose. Aside from its sharpness qualities, the emulsion looks, handles and is processed in the same way as others used for decades in the production of optical sound negatives.

Some idea of the film track's data storage capacity is given by Kodak: it needs to handle 5.5 million bits of data per second. A key component of the decoder is a proprietary error detection and correction system developed by Cyclomics, a Kodak-owned company that specialises in the design and manufacture of high tech ICs, for satellites.

Following the recording of the sound negative, it is processed conventionally, then used to imprint its information alongside the picture on the final release print.

To reproduce a print carrying CDS, a theatre will need to purchase and install the processor. This consists of two elements; a scanner and a digital decoder.

The scanner, a CCD array, reads the digital information and converts it to electrical impulses. The decoder converts this track into the six analog audio channels, and the three digital data streams.

The specs are staggering, especially when the running speed of the 70mm print – 56cm per second – is considered:

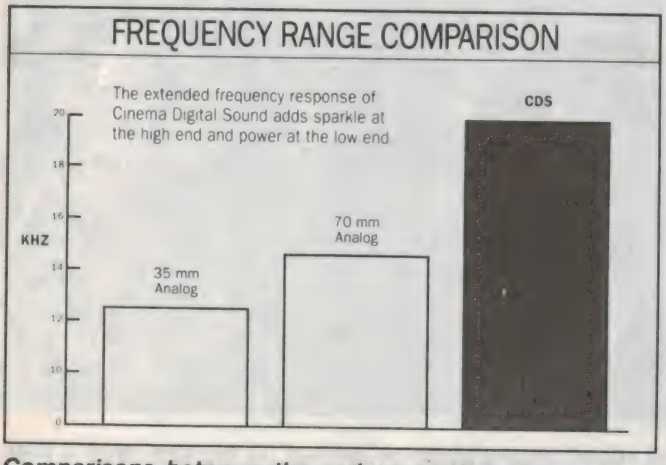
- Six channels of audio
- Dynamic Range: 96dB
- Channel Separation: 100dB
- Frequency Range: 20-20,000Hz
- Total Harmonic Distortion: 0.01%

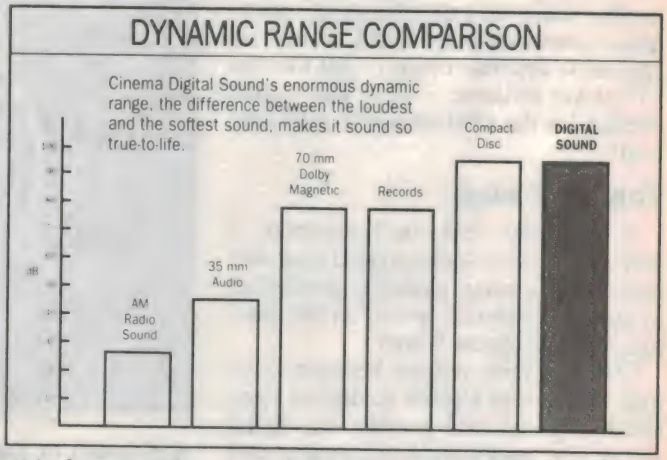
The process has had a long gestation. Some years ago Kodak presented a paper to the SMPTE outlining their research into digital cinema sound. Soon after, ORC contacted the Rochester company and revealed they had been

MOTION PICTURE SOUND SPECIFICATION COMPARISON

FEATURE	35 mm "ACADEMY" OPTICAL	35 mm DOLBY STEREO OPTICAL	70 mm DOLBY MAGNETIC	
Number of Channels	1	2 matrixed to 4	4 full-bandwidth 1 subwoofer	5 full-bandwidth 1 subwoofer
Dynamic Range New Print Worn Print	 52 dB 44 dB	 59 dB 51 dB	 78–80 dB	 96 dB 96 dB
Channel Separation	NA*	12–49 dB	50 dB	100 dB
Frequency Range	30–6,300 Hz	40–12,500 Hz	30–14,500 Hz	20–20,000 Hz
Total Harmonic Distortion	1–7%	1–7%	3%	0.01%
Control Channel	None	None	None	MIDI
Synchronization Track	None	None	None	SMPTE Time Code
Film ID Information	None	None	None	ID Data Fields

*Note: NA = not applicable





Comparisons between the various motion picture sound formats in current use, and the new CDS system. There's a dramatic improvement in frequency response, dynamic range and distortion performance.

A 70mm projector with the CDS track scanner fitted – the light coloured compartment just above the main film gate, at upper right. (Courtesy Eastman Kodak Australia).

pursuing similar research. Joining forces was an obvious outcome of the contact.

70mm first

At first CDS will only be available in 70mm format, with 35mm versions expected to be in theatres by mid-1991.

70mm presentations were chosen as a priority because of existing high audience expectations of audio to accompany the high resolution of the picture. And all of the theatres currently equipped for 70mm presentation already have six-track stereo speaker installations.

However the biggest breakthrough will occur when the new digital sound system is applied to 35mm release prints. As an illustration, current 35mm optical sound delivers a frequency range of only 30 – 6300Hz, with harmonic distortion that can reach figures of 7%. Even 70mm Dolby magnetic delivers a range of only 30 – 14,500Hz, with a distortion figure of 3%.

The higher level of quality delivered by CDS will not only enhance the audience's enjoyment of the film – no pops, squeaks, crosstalk, background 'hash' – it should also change the way a film is constructed.

Scripts can now begin to use sound – and the absolute absence of it – as a dramatic element. A very slight, low level sound effect will now be heard so clearly that the astute film-maker can use its introduction as a plot device. In theory, because the sound would have such an enormous dynamic range there could be a lowering of general level in the auditorium – addressing a constant complaint aimed at the George Lucas style of 'molto voce' space saga that has beset our theatres in recent years.

And producers intent on pushing their hapless audiences to the absolute limits can hook into the digital control tracks to marry the 'ultimate' in sound with the ultimate in physical torture: the MIDI and SMPTE tracks could be used to trigger light effects, generate laser beams, fire small in-theatre explosions, pump smoke, or control the hydraulics on specially constructed tilting, tipping, tickling theatre seats!

The ID track could prove useful as an anti-piracy measure, preventing illegal, unauthorised copies of the sound track to be made without the appropriate decoding.

It is expected that release prints will be easier to make, and their life extended due the superiority of CDS as an audio storage medium compared to conventional analog optical sound tracked, or magnetic tracked prints: less problems from scratches with the former, less head wear and dropouts with the latter.

Tests indicate that CDS prints can be run a thousand times without noticeable change in the audio quality.

Industry response has been high, with high praise for the system issuing forth from Disney, Fox and Warner studios.

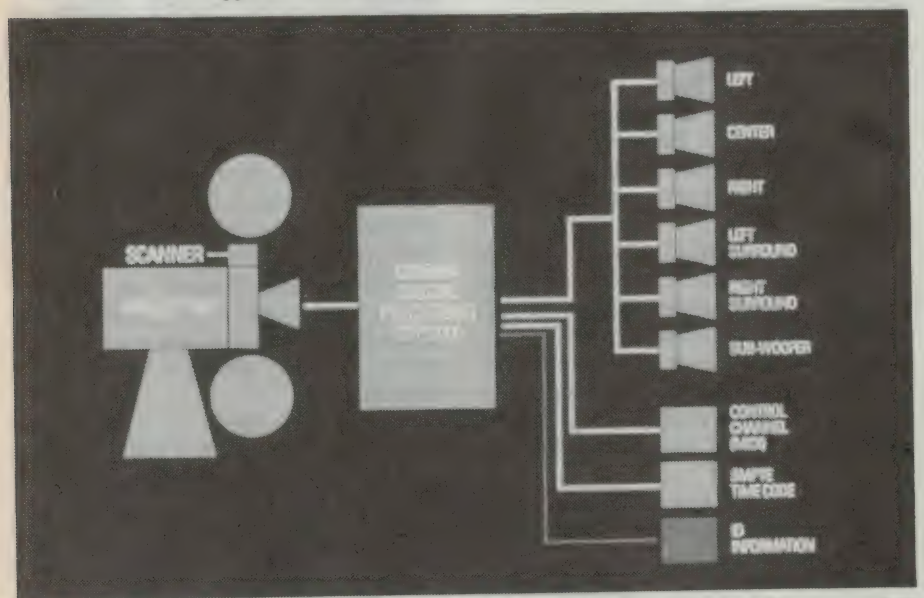
Richard Stumpf, Universal's VP Engineering and Development, believes CDS 'will rank as one of the most significant and technical contributions to the industry'.

An engineer with Lucasfilm – Buzz Hays – said "The most important benefits are probably things we haven't even thought of yet."

Ted Gardner, of the Motion Picture Association is enthused about the system's "potential for thwarting piracy – if certain procedures can be implemented."

Four studios have committed themselves to releasing major features with Cinema Digital Sound: *Back to the Future III*, *Die Hard II*, *Robo Cop II* and *Dick Tracy*.

Perhaps, in the near future, we'll also see the umpteenth revival of *Gone With the Wind* – with CDS!



The CDS decoding process, which takes place in the cinema: the encoded data is scanned and processed to recover six audio and three data/control tracks. (Courtesy Eastman Kodak Australia).

Silicon Valley NEWSLETTER

Ramtron opens first FRAM foundry

Ramtron Australia's majority-owned microelectronics subsidiary, Ramtron International Corporation has officially opened its new research and development and manufacturing facility in Colorado Springs, the world's first dedicated to Ferroelectronic Random Access Memory (FRAM) technology and products. Ramtron began processing semiconductor wafers in the facility in June.

The new US$26 million 69,000 square foot facility was opened by Colorado Congressman Joel Hefley in the presence of distinguished guests – which included the Australian Consul-General Mr John Kelso. A number of investors from Australia also attended together with the company's directors, management and staff.

Located on a 32 acre site north of Colorado Springs, the facility is equipped for pilot production of memory chips of up to 4-Mbits, and has a capacity of approximately 6500 wafers per month.

Mr Brian Harcourt, Chairman of Ramtron Australia Ltd, said "The manufacturing capacity of Ramtron's new facility, combined with those of Ramtron's co-development and manufacturing partners – NMB Semiconductor and Seiko Epson Corporation – will provide the capacity required to serve the global markets for Ramtron's memory products."

Mr Harcourt added that the facility significantly expands the company's research and development capabilities for sub-micron products of 4-Mbit and higher density.

Intel worker caught selling hot chips

Some of the year's biggest chip transactions are claimed to have taken place recently in a shopping centre parking lot in Santa Clara. There, Wayne Loeffler sold some US$700,000 worth of valuable Intel microprocessor chips to a gray-market chip broker.

Needless to say the deal wasn't very legitimate and police, who had secretly filmed the transaction, arrested the 22-year-old Intel worker on charges that he stole the chips from his employer.

The transactions with the chip brokers involved hundreds of Intel's 386 and 487 microprocessors, chips that are selling for between US$400 and $1200 apiece.

According to police statements, Loeffler worked at Intel as a truck driver, delivering large quantities of chips between the various plants and office buildings Intel has in Silicon Valley. Knowing where he left the boxes, Loeffler would come back after work and load them into his car.

Valley's first superconductor chips

Hoping to get a headstart on future competitors, superconductor start-up Conductus has opened Silicon Valley's first operational superconductor components production line.

Despite its vast potential, Conductus faces major challenges, not the least of which is that the small Sunnyvale company will have to create its own market – traditionally a slow process that will keep corporate growth rates at modest levels.

Conductus, in 1987, was one of the first start-ups formed after the discovery of a new class of high-temperature superconductors. Its six founders are former Stanford and Berkeley university scientists. The firm received start-up capital from venture capitalists and Hewlett-Packard.

Conductus superconductor 'chips' are produced much like ordinary semiconductors, in which wafers are coated with superconductor material after which circuits are etched into it. The main difference is that to function, the chips must be kept in liquid nitrogen tanks at temperatures of some minus 240° Fahrenheit.

The company's first products include a super-sensitive halometer (an infrared light sensor), developed with the help of a US$50,000 grant from the US Army. The sensor is likely to be incorporated in future military satellites, where it will vastly improve the satellite's ability to detect and analyse enemy missiles by the 'signature' of the missile's exhaust.

The sensor can also be used to observe distant stars, and Conductus is talking to NASA about incorporating the component into a future Saturn probe.

A second product, a so-called superconducting quantum-interference device (squid) could be used to help predict earthquakes, by measuring minute changes in the Earth's magnetic field near potential quake areas. It has been discovered that the Earth's magnetic field changes slightly just before an earthquake.

In more immediate applications the Conductus squid can be used for tracking enemy submarines and in medical equipment for monitoring heart and brain activity by measuring tiny variations in the body's own minute magnetic field.

Refrigerator runs on sound

In a breakthrough development that could result in a new generation of environmentally safe refrigerators, air conditioners and other cooling systems, researchers at the US Naval Academy in Monterey, California have built a cooling system driven by ear-shattering noise.

The so-called 'cyclocooler', is built around a small high-power loudspeaker the size of a match box, that is capable of producing a volume of noise equivalent to almost two heavy-metal rock concerts or the blast-off of a Saturn rocket used in the Apollo program. Because the system is solidly enclosed, the system appears virtually quiet on the outside.

The speaker blasts its sound waves into a narrow tube filled with helium or some other environmentally safe gas. The vibration of the sound waves excites the gas molecules, heating and expanding the gas as the sound waves pass through.

Next, the compressed gas enters a heat/cold exchange chamber where it expands, causing the gas to quickly cool

down. The cold is then extracted from the chamber and used for cooling purposes. In reverse, the system can also be used to generate heat.

So far the academy has only built a small prototype and is waiting for additional funding to build a full-scale model. But already the Navy said it has entered into negotiations with at least one manufacturer interested in commercialising the technology. The Navy said it plans to use the system for cooling applications on the US space station and the shuttle.

Navy cancels Lockheed contract

Lockheed Missiles & Space is reeling in the wake of a decision by the US Navy to terminate a US$3 billion order of the next generation of P-7A anti-submarine patrol planes. According to the Navy, Lockheed has been unable to make sufficient progress towards completion of the development of the P-7A. Also, the cost of the planes has risen far above the original estimates.

Lockheed said the Navy has no rights to cancel the contract for the reasons that it stated. Any delays and cost-overruns were due to a number of changes the Navy requested in the design of the planes, which are loaded with tens of millions of dollars worth of sophisticated electronic gear that can detect Soviet submarines and track their course.

"We believe the Navy has no legal or contractual basis for the termination. We are confident that the appeal will be resolved in our favour," said Lockheed chairman Daniel Tellep.

Losing the P-7A contract could cripple Lockheed, which has been providing the Navy with its current generation P-3 surveillance planes for more than three decades. The loss of the contract, involving some 120 planes, could cause the company to lay-off thousands of workers and may severely undercut its financial stability.

Revolutionary graphics chip

Edsun Laboratories, a tiny Massachusetts chip start-up, has announced the development of a breakthrough chip that could vastly boost the graphics quality of most personal computer displays to the same level as high-powered workstations.

Edsun said its US$20 'Continuous Edge Graphics' chip does exactly what its name implied. It manipulates video signals in a way that smooths the jagged edges that distort lines and images on most standard personal computers.

The chip directly alters the video signal, in a such way that it expands the palette of colours that fill the thousands of pixels on a display. The chip makes some 740,000 colours available on the display, compared to the normal 256, by incremental shading of each pixel, the edges between the pixels are smoothed, allowing lines of graphic images to become equally straight and smooth looking.

Currently, computer makers have only been able to smooth images by increasing the number of pixels or by expanding the number of colours. But those methods are expensive on the overall cost of the system, as they require vast amounts of system memory and processing power.

Industry analysts say the chip represents a major technological advance. "We think it has a great future," said creative Strategies analyst Tim Bajarin.

The development is also satisfying for another company, Analog Devices, which provided the key design tools that enabled Edsun to develop the proprietary chip design. EA

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AMATEUR RADIO OUT OF A SUITCASE

As a result of the author's profession, he is forced to spend a considerable amount of time 'on the road', and staying overnight in country motel rooms. Here he relates his success at whiling away the lonely hours operating a portable amateur HF-SSB transceiver rig, which fits into a small 'attache' case.

by PETER R. JENSEN (VK2AQJ)

Someone once said that 'It is better to travel than to arrive', and for anyone who does a lot of travelling around the country towns of New South Wales, never a truer word was spoken. However glamorous it might seem to be away from the 'big smoke' the awful reality of living in motels, away from the comforts of home, is the high level of boredom that is inevitable.

One of the small advantages that the itinerant radio amateur has available, is access to the radio waves and the companionship of other radio amateurs. Not that the level of conversation is all that elevated, but it certainly beats the local television station, hands down.

However what makes all the difference, these days, between access to the radio waves and being able to use them constructively, is access to equipment that is small enough to take around in one's baggage.

It might well be thought that, with that introduction, the topic of this discussion would be operations with a two-metre hand held. Well, that *has* been tried by this particular bored radio amateur. The problem is that many locations at which one stays are well away from the local repeater. Apart from that, 'simplex' is just not on with only 1.5 watts of radio frequency power and frequency modulated at that. As other isolated and lonely amateurs, whiling away long evenings in the average country town have no doubt discovered, the only solution is CW or SSB.

Much as I would love to conduct long contacts with CW, the unfortunate fact is that for me this skill was learned just too late for adequate receiving speed to be available, which would make the QSO enjoyable. No doubt there are many amateurs and ex-CBers who are in the same position.

This therefore leaves SSB as the inevitable choice. With this decided then, the next question is what transceiver to use.

Which rig?

To some extent the answer to this question has to be a function of one's access to finances, on the one hand, and one's technical skill on the other. However as much of the author's travelling is by air, this imposes another limitation on the form of the transceiver. This is of course the question of weight.

When one comes to look at the different types of transceivers available, from the point of view of weight, then there is really only one serious contender around: That too is getting a little hard

All unpacked and ready to operate – the author's briefcase station. The shot at lower left shows it when all packed up.

to obtain. I refer to the Dick Smith Electronics kit transceiver designed by Gary Crapp (now Cratt) and Gil Macpherson, some years ago.

While it is a mono band device and is limited to that extent, it more than makes up for this by being far and away the lightest and most compact of transceivers that this amateur has seen on the HF bands. In reality it is small enough to fit inside a modest briefcase together with all the necessary battery pack, antennas, microphone, antenna tuner and accessories required to make portable operations feasible away from the home base.

Reference to the accompanying illustration will demonstrate that this is no exaggeration.

What is rather surprising, in this context, is that so far no major manufacturer such as Yaesu or Kenwood has done anything about making a really small multi-band portable HF transceiver. Their products just seem to be getting ever more massive, complex and incredibly expensive. Perhaps that clever Mr. Icom will take some notice of this article and do something about the situation.

The particular transciever built up was that presented in *Electronics Australia*, originally. This was designed for use on 80 metres, which means that a fairly substantial antenna is required. However it does have the benefit of allowing both novices and full calls to have access to the lower part of the HF band, which is no doubt the most useful for general, around Austalasia, chatting.

Undoubtedly the 40 metre band would be worth investigating too, and the conversion kits are probably still available. Certainly the antenna would be half the size of the 80 metre antenna and this would make installation in the average motel a lot easier.

Having touted for the DS transceiver, it has to be said that it is not a kit for the inexperienced, as it has a very large component count. Apart from basic electronics knowledge, a fairly systematic and careful approach to construction is required, not to mention a fair degree of patience and skill with a soldering iron. In addition, if you are in the same age bracket as the author, you too may have to resort to a head band with stereo magnifying eyepieces in order to see the solder joints that have to be made, without running onto adjoining tracks.

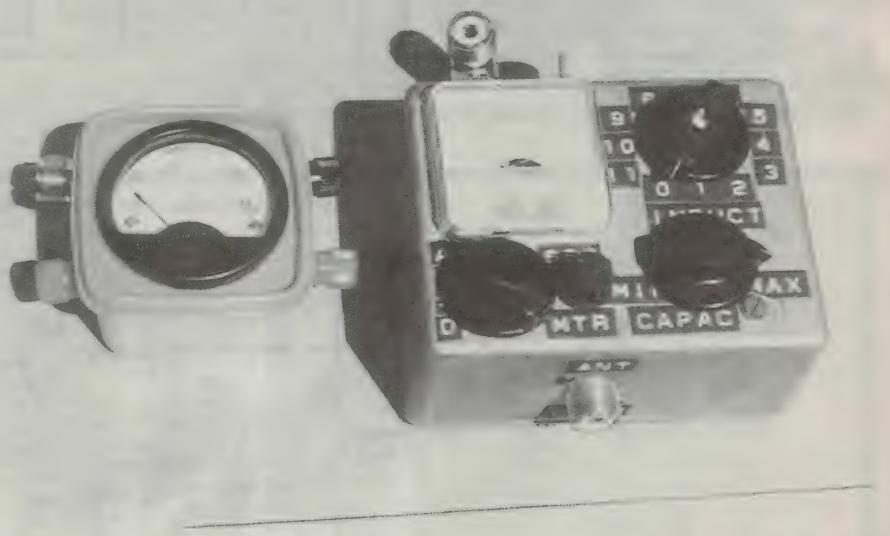
So, making the very bold assumption that you are one of the intrepid amateurs that has made a DSE HF transceiver, I will now proceed on the basis that some suggestions as to portable operations in practise may be useful.

Perhaps the first place to start is with the antenna, for there is no doubt that without an effective system, low power operations will inevitably result in a high level of frustration.

The antenna

Over the last ten years all sorts of antennae have been tried in the portable situation and in the end it is the simple tuned vertical, either made of wire or tube that has been the most successful. It is perhaps no coincidence that when one looks at Army equipment, almost universally it is the long whip antenna that one sees in use, not only on the backs of marching operators but on vehicles, tanks and troop carriers.

The simple truth is that 'long wires', which are in reality not very long and never seem to be very high, are difficult to set up physically and are relatively inefficient. By comparison the far more efficient dipole, either cut to frequency or in the form of a multi-band device



The author's home brew antenna bridge and tuner unit (right), together with his RF power meter. They make tuning up a breeze, he reports.

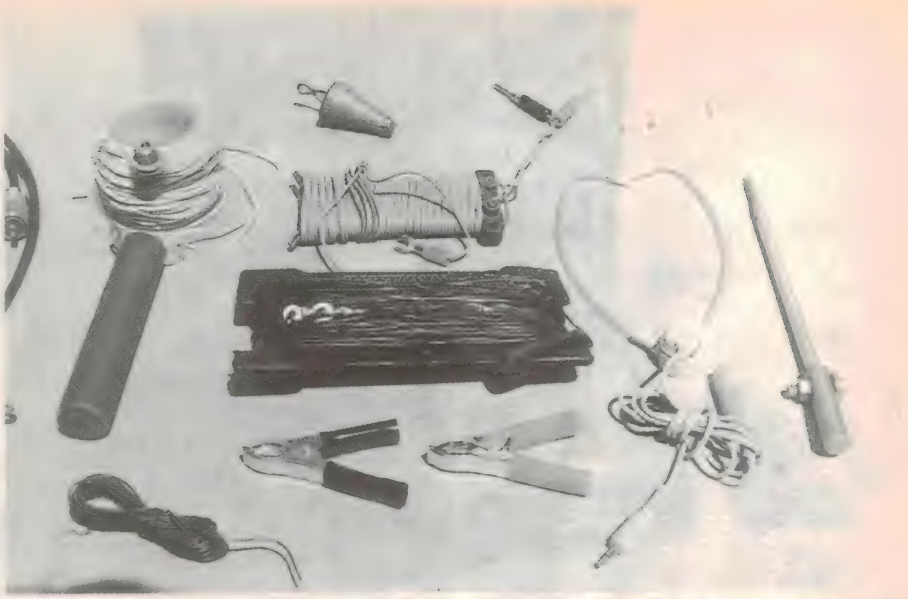
such as a G5RV antenna, is difficult to erect from inside a motel room and again usually suffers from inadequate height.

Other antennae tried have been centre-loaded whips with capacitive hats, and most recently a helical whip made up in demountable sections. This last is still being developed.

Having selected the ubiquitous vertical wire as the preferred antenna, the problem is to get it up in the air. Here a small sphere of lead and a long bricklayer's line made of nylon is indispensible. The lead is available as a fishing accessory in any sports store. As can be seen from the illustrations, the author has his line wound onto a plastic spool complete with winding handle.

With this arrangement all that is now necessary is that a large tree be close enough to one's motel room to be accessible. You would be surprised how few motels have suitable trees. There seems to be a quite extraordinary tendency to cut them down, and it becomes quite an exercise searching out the best motels with this in mind. Again finding a tree in a motel courtyard that you can actually throw a lead weight up into without smashing a window or landing on a tiled or metal roof can also be difficult.

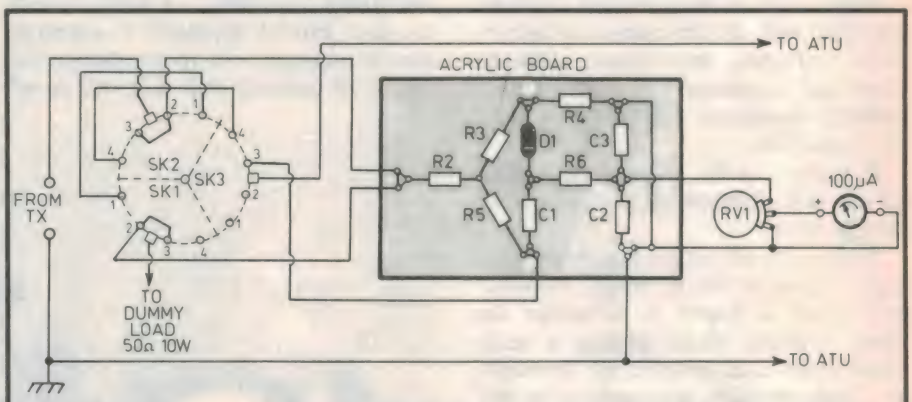
The critical component of the antenna is of course the wire used, and in this the author was fortunate to obtain a 'long wire' wound on a bobbin, originally supplied with the Army 510 sets of the late 1950's. The beauty of this antenna wire is that apart from the strands of tinned copper, which do most of the work, there is a reinforcing strand of high tensile stainless steel. This makes the antenna almost unbreakable, and when one is recovering it from the fork of a gum tree this can be rather useful.



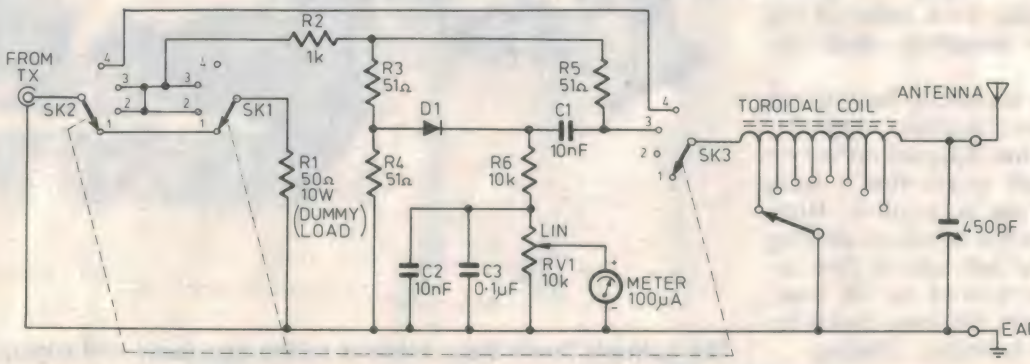
The temporary antenna and earthing system, together with accessories. At right is the author's rather nasty-looking earthing spike.

The wire is in turn covered with tough plastic and is thoroughly recommended if you can 'scrounge' such a component. It also has the advantage that the wire is broken up into a series of sections, connected together with metal hooks and eyes and so can be set up very easily to a length to match the particular situation in the motel.

In the absence of such a wire, there are several brands of multi stranded hook up wire available from the usual electronic suppliers. In addition, it has been noticed that army surplus field telephone cable also is made up from copper strands with a central reinforcing strand of steel wire. However if all else fails there is also the firm of Bambach, in the Northern Sydney suburb of Brookvale, which may be able to help by mail order.



Details of the antenna tuning unit and impedance bridge. Below is the overall schematic, while above are the bridge wiring details.



Matching

Assuming that the tricky problem of raising an antenna has been accomplished, the next thing is to match it to your transceiver. While the DSE rig is fairly tolerant of high SWR, there is no doubt that it reduces the RF output quite dramatically and therefore proper matching is essential.

In my early portable operations, using a small antenna matcher with a SWR meter was tried but always proved to be very 'tricky' and time consuming. In recent times a far simpler and more elegant system has been used involving an antenna impedance bridge and meter. This is based on a design published in *Amateur Radio*, and makes the matching of the antenna a twenty second 'snap' rather than 10 minutes of pure frustration.

As can be seen from the circuit diagram and the illustrations, the matching bridge has a four position switch. The first position is really redundant for the solid state transceiver, as it was designed to allow a valve power output stage to be tuned up into a small internal dummy load. It was included as a nostalgic tribute to all the many QRP valve transmitters that have been played with over the years.

Who knows, there may still be the odd 'Tucker Tin' using a 12BY7 output stage, which would find such a dummy load useful.

The next switch position allows the meter to be set to full deflection, with the power of the tranceiver applied to the dummy load via the bridge circuit. In this position, the DSE rig should be set to the CW position and keyed via a morse key plugged into the rear socket to provide the power.

Having set the meter for the power level in use, the matcher can be set to the third position and the impedance of the antenna matched by switching the inductance and tuning the capacitance until the meter reading falls back to as close to zero as possible. Once this has been done, the fourth position can be selected and you are ready to transmit. Again the total time to match the antenna rarely takes much over twenty seconds.

Bridge construction

Having given you some insight into the advantages of using a bridge form of matching device, rather than a simple antenna tuning unit with a standing wave ratio meter, it would be unfair not to give at least a short description of the construction of this useful piece of equipment.

Fully paid up members of the Wireless Institute of Australia may well have access to the original article as contained in the references. However for others without easy access to this august body, the following information is given.

In reality the circuit diagram gives most of the vital data required and all that is necessary is to make up a little circuit board and solder the various components to it. The author's approach to circuit boards of this level of simplicity involves sketching a layout of the components on tracing paper. This layout is then transferred to a piece of acrylic, and the intersections of components marked through the tracing paper with a sharp point.

The next step is to drill out holes to take the wires from the various components and then these are hooked together with solid fine gauge wire and the whole assembly soldered together. The result is rather like traditional point to point wiring and is certainly not as elegant as a circuit board. However while some would consider it 'cheap and dirty' it works well, does not involve messing around with chemicals and is very quick to put together. In other words, just the right answer for your average amateur.

The meter is from the same source as the transceiver, as are the other minor components. The toroid came from Davred Electronics, also located in that little ghetto of electronic retailers in York Street, Sydney, where all the dedicated radio amateurs meet from time to time.

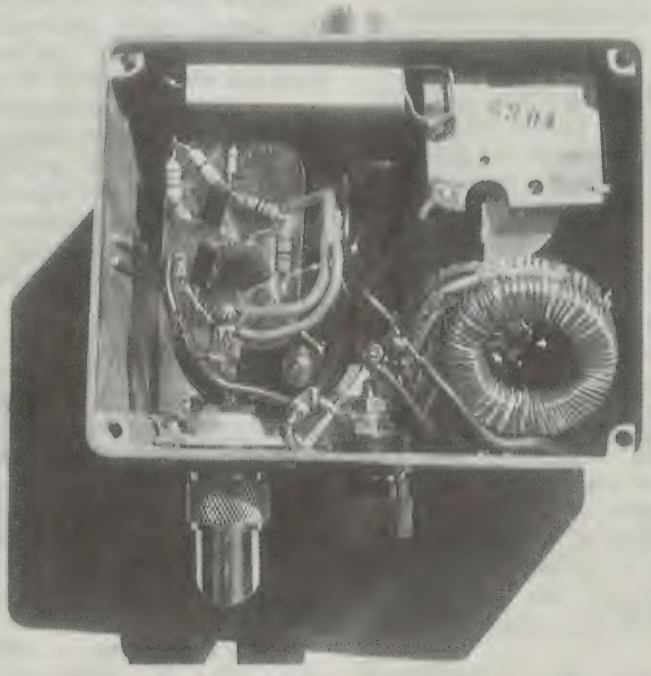
Finding an earth

Having put together this splendid little piece of equipment and before you can set it to work matching that vertical antenna, there is another vital element of the portable system required. This of course involves the essential step of establishing an earth or ground, to work the antenna against.

Again in a motel this can be a difficult problem. One might imagine that the plumbing pipes would give a good earth, on the cold water side. That certainly *can* be the case, but at times it doesn't seem to work, and if you are well away from the 'good earth' then you may have to resort to an old fashioned 'counterpoise'.

Where under normal circumstances the real earth provides the 'mirror' in which a replica of the quarter wave vertical is reflected, this can be achieved with a length of wire, a quarter wave in length, laid on the floor of your room. However this is not a recommended method of providing an earth, for motel colour televisions are highly sensitive to television interference from radio frequency radiation. Cheap sets seems to equal, inevitably, cheap front ends, susceptible to intermodulation distortion in the presence of even moderate RF loading.

In this respect the TV in your own



Inside the antenna bridge and tuning unit, housed in a diecast box. The large resistor at top is the 50-ohm 10W dummy load, R1.

room serves as a useful and sensitive monitor of the level of TVI generated. You can be fairly sure that if there are no sound bars across the screen in this TV, then there will not be stripes in adjoining rooms.

Even making a good connection to a close-by flower bed is frequently difficult in the typical country motel, even when you are located in a room at ground level. Many motel rooms have a blank back wall with no windows, and only the airconditioners are allowed to look out onto the side boundary. However assuming that you can sneak a wire out to ground level, the problem is to make a good contact.

Damp ground close to a tap is ideal. In the absence of a large sheet of copper sheeting set in a large hole – the traditional and preferred form of earth – you will have to make do with a ground spike. Again reference to the illustrations will show the vicious-looking device that was constructed by the author for this task. A perfect weapon for the villain of the Follet novel *Eye of the Needle*, no doubt, but it works fine as an earth contact too. The brass handle allows a terminal to be fitted and this in turn makes the attachment of an earth wire simple.

For those of you with a historical turn of mind, you will no doubt appreciate that the antenna and earth just described are the two vital elements that Marconi set to work, to turn the scientific novelty of Heinrich Hertz into a useful means of communication without wires.

The other interesting thing is that the power consumed by the DSE transceiver is quite similar to the first wireless transmitter made by Marconi. However where Marconi was able to communicate over a distance of 2 to 3 kilometres, the diminutive DSE rig is quite capable of communicating with New Zealand when the conditions are not unfavourable.

Power source

The next matter of importance is the form of power supply to be used. The DSE is not as efficient as other solid state transceivers, as it draws a good 5 amps to produce its 30 watts peak envelope power SSB. This is a very substantial amount of power to provide for portable operations, as any CBer would appreciate.

In the author's case, a power pack made up from Nickel-Cadmium cells has been the basis of the briefcase system, and when used sparingly can sustain a number of short contacts without 'falling over'. However a more useful approach has been to take along a compact 5 amp power supply to run off the mains. While it adds a fair bit to the weight of one's luggage, there is no fear that it will die in the middle of a stimulating conversation. Again it is surprising that no one has produced a compact and lightweight switch-mode power supply for portable operations. What about it, Mr Icom?

The author's compact 12V/5A mains power supply – again home brew. It's used when mains voltage is available, to save the NiCad battery pack.

There is of course another solution to the power supply problem, lurking under the bonnet of your car, if you have one with you. It is the car's own battery and subject to reasonable use it will allow many trouble-free contacts to be made. It is usually possible to take off power through the cigarette lighter socket, and of course away from the motel it is usually quite easy to find a suitable tree to sling an antenna up into.

Output monitor

The last device to be described is a meter for monitoring the output of radio frequency energy to the antenna. The author was fortunate to come across a hot-wire RF milliammeter in 'George's Bargain Bazzar' at Brookvale and with a suitable shunt to reduce the deflection of the meter, it works beautifully.

It is not necessary to calibrate this meter other than to set the shunt so that at full power, with a regular base station antenna, the needle deflects to about three-quarters of full scale. Of course the meter can only be used with a continuous wave output, as when the rig is operated in the CW position. However it is very comforting to get a high reading on the meter once the antenna is matched according to the bridge antenna matcher.

Although the portable station is certainly not the smallest system that could be achieved, it is possible to put it together without any impossible problems of miniaturisation. All the elements are available, or can be matched with some freely available substitute and the result is a useful and amusing rig that is far more fun than back episodes of 'Neighbours'!

If this article assists you in taking the step of trying portable operations, it will certainly have achieved its purpose. No doubt just putting it together back at the home base will keep you out of mischief and off the streets. However, more importantly, when away from the home base it will make a fine substitute for the bottle or the television. I shall look forward to meeting any other wandering hams, 'further down the log'.

References:

Swain, G., 'HF Amateur Transceiver', *Electronics Australia* October-December 1985.

Doyle, D. (VK6ABD), 'Safe Tune-up with the FT-7', *Amateur Radio* December 1985.

American Radio Relay League, *The ARRL Handbook*, 1988.

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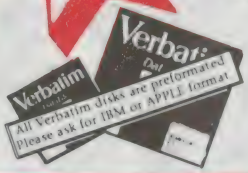

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Printing speed: 8 page/minute
Warm up time: 45 seconds
Resolution: Max 300 x 300 dots/inch
Automatic paper feed
Standard: 200 sheets
Option: a futher 200 sheets
Paper formats (automatic feed):
A4, A5, A6, B5 (weight 60-90g/m2)
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PRINTER MECHANISM:
Printer method: Dot matrix
Print head: 24 pins (diameter 0.2)
Head operating life: 200 Million characters
PRINTER SPEED:
Data: 270 cps (12cpi)
processing: 225 cps (10cpi)
Letter: 90 cps (12cpi)
quality: 75 cps (10cpi)
Charactera per line:
10 cpi 136
12 cpi 163
15 cpi 204
17.1 cpi 233
20 cpi 272
PRINTER CHARACTERISTICS:
Typeface
Standard: Courier, High Speed
Insert Cards: Letter Gothic, Prestige Elite
Software input: up to 256 characters as required
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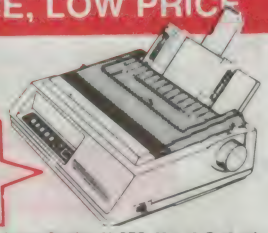

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Feed rate :	2.2 ips
Character Sets:	Standard ASCII Epson Charater Set IBM Set I and II Foreign Language sets Zero/Stashed Zero
Vertical Line Spacing:	Fixed / Varaible: 6 lpi n/60" ; 8 lpi n/180"
Print Direction:	Bidirectional, short line seeking

Letter Quality: 60 CPS 30 x 18 @ 12 cpi
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Print features:
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MTBF:4000 hours (25% duty cycle 35% page density)
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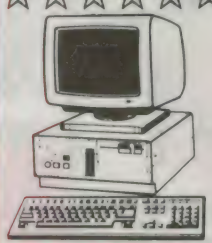

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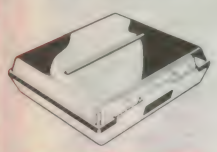

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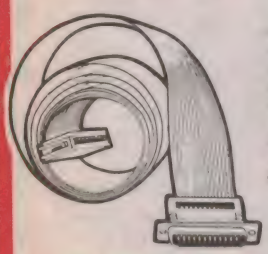

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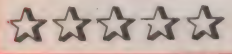

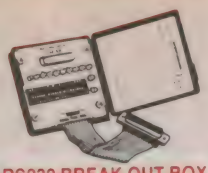

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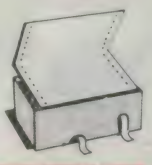

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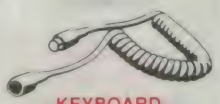
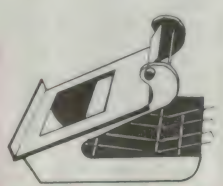
Cat. C21003 11 x 9½" **$41.00**
Cat. C21005 15 x 11" **$67.95**



KEYBOARD EXTENSION LEAD

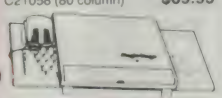
5 Pin Din plug and socket
P19038..... **$9.95**



DELUXE PRINTER STAND

- Restores order to your work area without occupying extra space
- Feeds and refolds paper under the printer automatically
- Adjustable paper deflectors ensure smooth flow of paper
- Made of moulded plastic
- Suitable for most printers

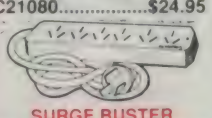
C21058 (80 column) **$69.95**



MAGIC STAGE

A working bench for your Mouse.
- High quality ABS plastic and anti-static rubberised top
- Stationary holder
- Includes pull-out shelf for Mouse
- Dimensions: 280 x 260 x 25mm
- Fits over keyboard

C21080.....**$24.95**



SURGE BUSTER

6 PROTECTED POWER OUTLETS ideal for protecting personal computers, video equipment, colour TVs, amplifiers, tuners, graphic equalisers, CD players etc

SPECIFICATIONS:
- Electrical rating: 240V AC, 50Hz, 10A
- 3 x Metal Oxide Varistors (MOV)
- Maximum clamping Voltage: each MOV: 710 volts at 50 amps
- Response time: Less than 25 Nanoseconds.

X10086.....**$69.95**

THE BUTTON SPIKE PROTECTOR

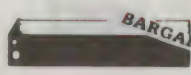
Surges and spikes are caused not only by lightning strikes and load switching but also by other equipment being switched on and off, such as fluorescent lights, electric motors fridge freezers, air conditioners, etc

For effective protection such spikes must be stopped before they reach your equipment. Simply plug The Button into an outlet and it will protect all equipment plugged into adjacent outlets on the same branch circuit The Button employs unique metal oxide varister technology and will dissipate 150 joules of electrical energy (nearly twice that of comparable surge arresters)

SPECIFICATIONS:
Voltage 240V Nominal
Total Energy Rating 150 joules
Response Time 10ns
Protection Level 350V peak

$36.95

RIBBONS



PRINTER RIBBONS TO SUIT:

- CP80, SX80, DP80, BX100, BX100, MB100

	1-9	10+
C22036..	$19.95	$17.95

- MX80, FX80, RX80, FX800, MX70, MX80, LX800

	1-9	10+
C22031....	$16.95	$15.25

- MX100, FX100, RX100,LQ1000

	1-9	10+
C22002....	$19.95	$17.95

- LX80

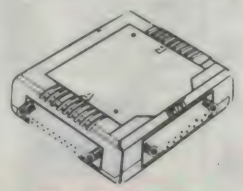
	1-9	10+
C22003..	$12.95	$11.95

- C ITOH 8510-1550

	1-9	10+
C22051..	$13.95	$12.50

NATIONAL PANASONIC KXM110 PRINTER RIBBON

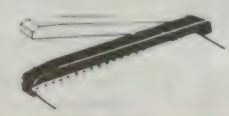
C22034.....$19.95



POCKET AUTO AB SWITCHES

- Pocket size, auto-scanning
- Allows 2 PCs to share one Printer

Serial model:
MS-201 - Host-powered
X19150.....$79.95
Parellel model: MP-201
Protocol transparent
X19155.....$89.95



RIPPER STRIPPER

Remove ugly paper feed edges quickly and cleanly with this simple little gadget
C21085.....$14.95

2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY Cat.X19120 only **$39**
4 WAY Cat.X19125 only **$49**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics Data Products, Epson, Micronics Star, and many other printer manufacturers
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY (X19130) ..... only **$49**
4 WAY (X19135) ..... only **$59**

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less time for less chips)
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased

Without timer
X14950..... **$129**
With built-in timer
X14955..... **$159**

DUST COVERS

DUST COVER

Keep your computer and accessories free of dust and grime while not in use
XT* Cover Set
C21066.....$14.95
AT* Cover Set
C21068.....$16.95

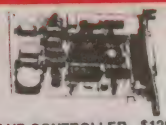
LEADS

PRINTER LEAD

- Suits IBM* PC/XT, compatibles
- 25 pin "D" plug (computer end) to Centronics 36 pin plug

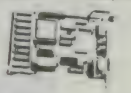
•1.8 metres
P19029.....$14.95
• 3 metres
P19030.....$19.95
• 10 metres
P19034.....$39.95

IBM* CARDS



XT HD CONTROLLER	$129
AT HD CONTROLLER	$199
RS232/ SERIAL/ CLOCK	$59
MONO/ COLOUR CARD	$96
MULTI I/O	$99
512K RAM	$59
DIAGNOSTIC	$849
TTL/ PRINTER	$89
RAM 2M AT EXT/EXP	$225
8M AT EXT/EXP	$325
FAX CARD	$595

4 PORT SERIAL	$89
VGA 256K	$199
VGA 512K	$299
VGA 1MEG	$495



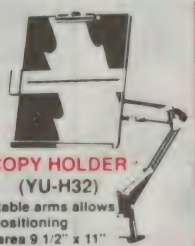
VOICE MAIL	$245
PRINTER CARD	$35
EGA CARD	$139
2 WAY FDD CONT. (360K)	$49
RS232 SERIAL/ CARD	$49
GAMES	$29
AT S/P GAMES	$35
4 WAY FDD CONT. (360-1.44M)	$129
2 WAY FDD CONT. (360-1.44M)	$80
CLOCK CARD	$49
SMART DRIVE ADAPTER IDE/FDC	$89
SMART DRIVE ADAPTER IDE I/O /FDC	$119

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T D Transmit Data
D S R Data Set Ready
R D Receive Data
C D Carrier Detect
R T S Request to Send
D T R Data Terminal Ready
C T S Clear to Send

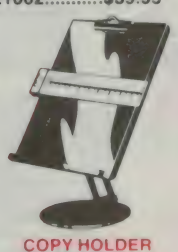
Cat. X15656 Normally $39.95
SPECIAL. ONLY $32.95



COPY HOLDER (YU-H32)

- Adjustable arms allows easy positioning
- Copy area 9 1/2" x 11"
- Sliding line guide
- Clamp mounting

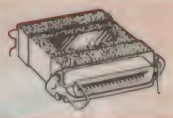
C21062.....**$39.95**



COPY HOLDER (YU-H33)

- Copy area 9½" x 11"
- Sliding line guide
- Flat metal base

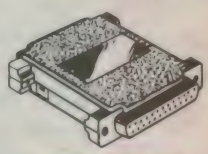
C21060 ..... **$39.95**



CENTRONICS GENDER CHANGERS

- Female to Female
- Saves modifying or replacing non-mating Centronics cables
- All 36 pins wired straight through

Cat. X15663 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15664 **Female to Female**
Normally $33.95.
Only $24.95



RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $14.95 each
Only $8.95

MOTHERBOARDS

XT 10M MINI	$120
XT 31M	$199
XT 12M STD. SIZE	$199
SUNTEC AT 12M	$375
80386-25... W/CACHE	$2,695
80386- 33.. W/CACHE	$2,995

ROD IRVING ELECTRONICS

SYDNEY: 74 Parramatta Rd Stanmore 2048
Phone (02) 519 3134
Fax (02) 519 3868

MELBOURNE: 48 A Beckett St
Phone (03) 663 6151

NORTHCOTE: 425 High St
Phone (03) 489 8866

CLAYTON: 56 Renver Rd
Phone (03) 543 7877

MAIL ORDER & CORRESPONDENCE
P.O. Box 620, CLAYTON 3168
Order Hotline 008 33 5757
(Toll free, strictly orders only)
Inquiries: (03) 543 7877
Telex AA 151938
Fax (03) 543 2648

MELBOURNE DEALERS

MICRODOT
177 SPRINGVALE ROAD
NUNAWADING. Ph.894 1255

GREENSBOROUGH COMPUTERS
57 GRIMSHAW ST
(cnr Howard st) Ph: 434 5166

BRISBANE DEALER

VRC COMPUTER SERVICE
647 LUTWYCHE RD
LUTWYCHE, 4030

ADELAIDE DEALER

MICROTRONICS
305 MORPHETT ST
ADELAIDE, 5000

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE
56 Renver Road, Clayton
Phone (03) 543 2166 (3 lines)
Fax (03) 543 2648

For postage rates refer to other R.I.E advertisement

Errors and omissions excepted
Prices and specifications subject to change

MasterCard VISA

ROD IRVING ELECTRONICS

QUALITY COMPONENTS

GREAT

NEW 52 PAGE CATALOGUE WITH 13 PAGES OF DATA SENT FREE WITH EACH MAIL ORDER OR ELSE CALL INTO ONE OF OUR STORESAND PICK ONE UP FOR ONLY $1.00....

COMPUTER CABLE

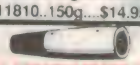
- Six conductor shielded computer interface cable
- m = metre

	1-9 m	10+ m	100+ m
W12670 - CIC6	$1.30m	$1.10m	$1.00m
W12672 - CIC9	$1.60m	$1.50m	$1.20m
W12674 - CIC12	$2.50m	$2.20m	$1.90m
W12676 - CIC16	$3.50m	$3.20m	$2.50m
W12678 - CIC25	$3.90m	$3.40m	$3.00m

HEATSINK COMPOUND

Heatsink compound is applied to the base and mounting studs of transistors and diodes. It maintains a positive heatsink seal that improves heat transfer from the device to the heatsink, thus increasing overall efficiency.

H11800 .10g.....$2.00
H11810..150g....$14.95



CANNON TYPE 3 PIN LINE MALE

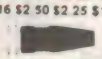
	1-9	10+	100+
P10960	$4.75	$3.90	$3.00

BNC MALE PLUG

	1-9	10-99	100+
P10514	$2.50	$2.25	$1.50

BNC PANEL SOCKET

	1-9	10-99	100+
P10516	$2.50	$2.25	$1.50



BNC CRIMP PLUG

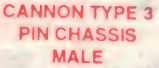
	1-9	10-99	100+
P10530	$2.95	$2.75	$2.00

BNC SOLDERLESS TWIST ON PLUG

	1-9	10-99	100+
P10531	$2.50	$2.25	$2.00

CANNON TYPE 3 PIN CHASSIS MALE

	1-9	10+	100+
P10962	$3.95	$3.50	$2.90

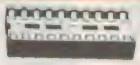


CANNON TYPE 3 PIN LINE FEMALE

	1-9	10+	100+
P10964	$4.50	$4.20	$3.20

CANNON TYPE 3 PIN CHASSIS FEMALE

	1-9	10+	100+
P10966	$5.95	$5.50	$4.00



LOW PROFILE IC SOCKETS

Save a small fortune on these "Direct Import" low profile ic sockets! PCB mounting solder tail. All tin plated phosphor bronze or berrylium and dual wipe for reliability

Cat. No.	Description	1-9	10+
P10550	8 pin	$0.20	$0.18
P10560	14 pin	$0.25	$0.20
P10565	16 pin	$0.25	$0.20
P10567	18 pin	$0.40	$0.35
P10568	20 pin	$0.40	$0.35
P10569	22 pin	$0.40	$0.30
P10570	24 pin	$0.40	$0.30
P10572	28 pin	$0.50	$0.40
P10575	40 pin	$0.50	$0.40

SUPER HORN TWEETER

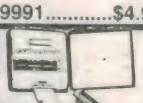
Requires no crossover and handles up to 100 Watts

Sensitivity: 100dB 0.5 m
Frequency response 3kHz-3-0kHz
Independence: 8 ohms
Size 96 m diameter
Normally $12.95
ONLY.....$9.95

ULTRASONIC TRANDUCERS

Designed to transmit at 40kHz (L 19990) and recieve at 40 kHz (L 19991)with up to 20V I/P on the transmitter. These units can't be heard so are ideal for TV remote control's , water level detectors, burglar alarms, motion detectors and information carriers as they can be either pulsed or used in a continuos wave mode.

Transmitter
L19990.....$4.95
Receiver
L19991.....$4.95



RS232 BREAK OUT BOX

A Simple way of monitoring RS232 interface lead activity Interface powered pocket size for circut testing , monitoring and patching. 10 signal LEDS and 2 spares 24 switches enables you to break out circuts or reconfigure and patch any or all the 24 active positions.

SPECS:
Connections: DB25 plug on 80mm ribbon cable and DB25 socket
Indications: Tricolour Leds for TD RD RTS CTS DSR CD TC RC DTR (E) TC
Jumper wires: 20 tinned end pieces
Power: interface power
Dimmensions: 85 x95 x30m m
X15700.....$94.95

VOLTAGE REGULATORS BARGAINS

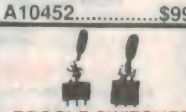
Description	1-9	10+
7805UC	$0.50	$0.45
7812UC	$0.50	$0.45
7815UC	$0.50	$0.45
7905UC	$0.60	$0.55
7912UC	$0.60	$0.55
7915UC	$0.60	$0.55
78L05	$0.45	$0.40
78L12	$0.45	$0.40
LM324	$1.00	$0.90
555	$0.40	$0.38
741	$0.50	$0.45

DB25 CONNECTOR SPECIALS

		1-9	10+
P10885	DE9S	$1.00	$ 0.70
P10890	DA15P	$1.00	$0.70
P10891	DA15S	$1.00	$0.70
P10892	DA15C	$1.00	$0.80
P10894	DA15P	$1.00	$0.80
P10895	DA15S	$1.00	$0.80
P10902	DB25C	$1.00	$0.80
P10905	DB25P	$1.00	$0.80
P10905	DB25S	$1.00	$0.80
P10884	DE9P	$1.00	$0.80

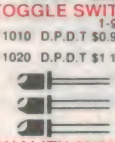
CRYSTAL LOCKED WIRELESS MICROPHONE & RECIEVER

MICROPHONE SPECS:
Transmitting Frequency 37.1MHz
Transmitting system: Crystal oscillation.
Microphone : Electret condenser
Power supply:9V battery
Range: 300 feet in open field
RECIEVER SPECS:
Receiver freq: 37.1MHz
Output level: 37mV(max)
Receiving sys: Super crystal oscillation
Power sup: 9V battery
Volume control: Tuning Led
Dimmensions:115x32x44mm
Weight: 220grams
A10452.....$99



TOGGLE SWITCHES

	1-9	10-99
S11010 D.P.D.T	$0.90	$0.80
S11020 D.P.D.T	$1.10	$1.00



QUALITY 3MM LEDS

	1-9	10-99	100+
Z10140(R)	$0.15	$0.12	$0.10
Z10141(G)	$0.20	$0.25	$0.12
Z10143(Y)	$0.20	$0.15	$0.12
Z10145(O)	$0.20	$0.15	$0.12

QUALITY 5MM LEDS

	1-9	10-99	100+
Z10150(R)	$0.15	$0.10	$0.10
Z10151(G)	$0.20	$0.15	$0.12
Z10152(Y)	$0.20	$0.15	$0.12

NICADS

Save a fortune on expensive throw away batteries with these quality Nicads and Rechargers!

Size	Desc.	1-9	10+	100+
AA	450mAH	$1.95	$1.75	$1.50
C	1 2 A H	$9.95	$9.50	$8.95
D	1 2 A H	$9.95	$9.50	$8.95

12V DC FANS

80 x 80 x 25.4mm
12V DC 1.7 Watt 0.14 Amps
T12469.....$12.95
10+ fans only $11.95 each

FANS

Quality fans for use in power amps, computers, hotspot cooling etc. Anywhere you need plenty of air

240V 4.5.8"	T12461	$14.95
115V 4.5.8"	T12463	$14.95
240V 3 1/2"	T12465	$14.95
115V 3 1/2"	T12467	$14.95

10+ fans (mixed) only $13.95 each

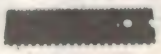
PANEL METERS GALORE

We have a great range of panel meters at great prices!

Q10500	MU45 0-1m A	$12.50
Q10502	MU45 50-50uA	$12.50
Q10504	MU45 0-100uA	$12.50
Q10510	MU45 0-5A	$12.50
Q10518	MU45 0-1A	$12.50
Q10520	MU45 0-1A	$12.50
Q10525	MU45 0-20V	$12.50
Q10530	MU52E 0-1A	$14.50
Q10533	MU52E 0-5A	$14.95
Q10535	MU45 VUP	$14.95
Q10538	MU65 0-50uA	$16.95
Q10540	MU65 0-1mA	$16.95
Q10550	MU65 0-100uA	$16.95
Q10560	MU650-20V	$16.95

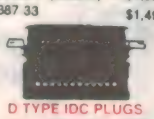
MOSFET SPECIALS

	1-9	10+
2SJ49	$7.50	$7.00
2SJ56	$10.00	$9.50
2SK134	$6.90	$6.50
2SK176	$9.50	$8.90



8087 CHIPS

8087-3	(4.77MHZ)	$175
8087-2	(8MHZ)	$265
8087-1	(10MHZ)	$395
80287-6	(6MHZ)	$295
80287-8	(8MHZ)	$395
80287-10	(10MHZ)	$495
80387-16	(16MHZ)	$795
80387-20	(20MHZ)	$895
80387-25	(25MHZ)	$1.095
808387 33		$1.495



D TYPE IDC PLUGS

	1-9	10+	100+
- DE9P 9 pin plug			
P12166	$2.95	$2.50	$2.00
- DA15P 15 pin plug			
P12168	$3.50	$3.00	$2.50
- DB25P 25 pin plug			
P12170	$3.95	$3.50	$2.95

D TYPE IDC SOCKETS

		1-9	10+	100+
- DE9S	9 pin socket			
P12167		$2.95	$2.50	$2.00
- DA15S	15 pin socket			
P12169		$3.50	$3.00	$2.50
- DB25S	25 pin socket			
P12171		$3.95	$3.50	$2.95

FLASHING LEDS

	1-9	10+
red 5mm Z10159	$1.10	$1.00

RECTANGULAR LEDS

	1-9	10-99	100+
RED	20c	15c	12c
GREEN	20c	15c	12c
YELLOW	20c	15c	12c
ORANGE	20c	15c	12c

ELECTRET MIC INSERTS

(With pins for easy board insert) Cat. C10150

1-9	10+	100+
$1.20	$1.00	$0.90

IDC CENTRONICS 36 WAY PLUG & SOCKET

- Plug P12200

1-9	10+	100+
$3.95	$3.00	$2.95

- Socket P12201

1-9	10+	100+
$3.95	$3.00	$2.95

WIRE WRAP IC SOCKETS

These quality 3 level wire wrap sockets are tin-plated phosphor bronze.

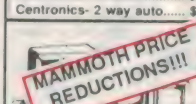
		1-9	10+
P10579	8 pin	1.50	1.40
P10580	14 pin	1.85	1.70
P10585	16 pin	1.95	1.80
P10587	18 pin	1.95	1.80
P10590	20 pin	2.95	2.75
P10592	22pin	2.95	2.70
P10594	24 pin	3.95	3.50
P10596	28 pin	3.95	3.50
P10598	40 pin	4.95	4.50

DATA TRANSFER SWITCHES

If you have 2 or 4 compatable devices that need to share a third or fifth, then these inexpencivedata tranfer will save youthe time and hassle of constantly changing cables and leads around.

No power required
Speed and code tranparent
Two or four position rotary switch on front panel.
Switch comes standard with female connector.

RS232- 2 way	$39
RS232- 4 way	$59
RS232- X over	$69
RS232- 2 way auto	$69
Centronics- 2 way	$49
Centronics- 4 way	$69
Centronics- X over	$69
Centronics- 2 way auto	$79



ECONOMY TRANSFORMERS

	1-9	10+
2155 240V 6-15V 1A		
Cat M12155	$8.95	$7.95
2156 240V 6-15V A2		
Cat M12156	$13.95	$12.95
2840 240V 9VCT		
Cat M12840	$4.95	$3.95
2851 240V 12-6V CT 250mA		
CatM12851	$4.95	$4.50
2860 240 V 15VCT 250m A		
Cat M 12860	$4.95	$4.50
6672 240V 15 30vc 1A tapped		
Cat M16672	$12.95	$11.95

PCB MOUNTING SCREW TERMINALS

(INTERLOCKING ENDS)
These terminals feature interlocking ends to form any number of conections. Standard 5mm spacing pins

- P10520 2 way

1-9	10+	100+
$0.75	$0.70	$0.60

- P10521 3way

1-9	10+	100+
$1.00	$0.90	$0.80

10W HORN SPEAKERS

White durable plastic. 8 ohms
Cat C12010 Normally $11.95
$9.95

UTILITY BOXES

Plastic boxes with aluminium tops and available in four sizes. Very popular for projects and very economical!

H10101	150x90x50mm	$3.25
H10102	195x113x60mm	$4.50
H10103	130x68x41mm	$2.75
H10105	83x54x28mm	$1.95
H10110	120x65x38mm	$2.95
H10112	120x65x38mm (Metal Top)	$2.95

9 PIN TO 25 PIN CONNECTOR ADAPTORS

The perfect solution!
Features gold plated pins
X15668 DB9 Plug to DB25 Socket
X15669 DB9 Socket to DB25 Plug.
each $8.95

ROD IRVING ELECTRONICS

SYDNEY: 74 Parramatta Rd Stanmore, NSW
Phone: (02) 519 3134

MELBOURNE:
48 A'Beckett Street, City
Phone: (03) 663 6151

NORTHCOTE:
425 High St. Northcote.
Phone: (03) 489 8866

CLAYTON MAIL ORDER
56 Renver Road
Phone: (03) 543 7877
Fax: (03) 543 2648

MAIL ORDER & CORRESPONDENCE:
P.O. Box 620, Clayton, 3168
Order Hotline: 008 33 5757
(Toll free, strictly orders only)

POSTAGE RATES

$1 - $9.99	$3.00
$10 - $24.00.....	$3.50
$25 - $49.99.....	$4.50
$50 - $99.99.....	$6.00
$100 - $199.....	$7.00
$200 - $500.....	$8.00
$500 plus.....	FREE

The above postage rates are for basic postage only. Road freight, bulky and fragile items will be charged at different rates.

All sales tax exempt orders & wholesale inquiries to: RITRONICS WHOLESALE, 56 Renver Road, Clayton. Ph (03) 543 2166 (3 lines)

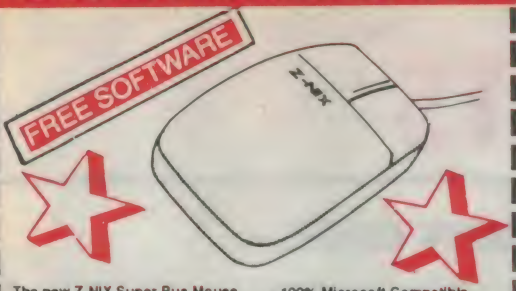
008 33 5757 TOLL FREE MAIL ORDER HOTLINE FOR CREDIT CARD ORDERS! LOCAL ORDERS AND INQUIRIES CALL (03) 543 7877.

WE HAVE OVER 6,000 ITEMS AVAILABLE!

ROD IRVING ELECTRONICS

SUPER BUS MOUSE 2

FREE SOFTWARE



The new Z-NIX Super Bus Mouse 2 allows you to get the most out of your computer and enhance your productivity. It gives you the ability to expand the versitility of your computer through the use of graphic software such as paint, draw and CAD programs. The Super Mouse 2 allows you to run programs like GEM and Windows which makes all operations of the computer easier and faster. Many popular Spreadsheets, databases, word processors and other programs can also be worked with the Super Mouse 2.

- 100% Microsoft Compatible
- IBM or APPLE Family Computer Compatible.
- Free Software with Pop-up Menus.
- Life time Warranty.

Also supplied with the Super Bus Mouse are two FREE Telepaint disks which allows the user to perform high resolution graphics with the mouse.Great Value!

X19951.....$119

HURRY! THIS OFFER CAN'T LAST

TOUCH MOUSE

A STATIONARY BREAK THROUGH

Now you can use your fingers instead of your mouse

MODELS: ATM- 110 Touch Mouse for IBM PC XT AT and compatible's. Operates under Microsoft ' mouse system mode.

FEATURES

- User's finger movements on the 58 X 48mm front panel of the touch mouse control the on- screen cursor movement.
- With no ball, the touch mouse requires no desk space for movement.
- No pad to get dirty and take up desk space.
- One finger can do all the users drawing.
- Compatible with all existing mouse software.
- RS- 232 serial port
- Especially suitable for laptops, the touch mouse saves on desk space.

FREE SOTWARE INCLUDED!

- MOUSE DRIVER
- TEST PROGRAM
- DEMO PROGRAM
- HIGH LEVEL LANGUAGE INTERFACE ROUTINE: Microsoft C, Microsoft Fortran, Quick Basic, Turbo C Pascal ...etc.
- POP-UP MENU
- DR. HALO III GRAPHICS SOFTWARE

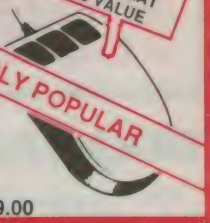
X19960.....$149.00

MICE

FREE MOUSE HOUSE & MOUSE MAT $20 VALUE

INCREDIBLY POPULAR

QUICK MOUSE



- Microsoft Serial Mouse
- Mouse System compatible
- Super high tracking speed 600mm sec
- Super high resolution 200 D.P.I. (0.12mm dot)
- Silicon rubber coated ball
- Optical rotary encoder

X19952.....$89.00

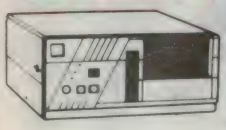
EVER POPULAR LOW BUDGET

WITTY MOUSE

- Three buttons, user definable
- Silicone coated steel ball
- High resolution movement of 195 dots inch. Smaller table space and less hand movement required
- Optical rotary encoder
- Max. tracking speed 200m sec
- Mouse resident firmware
- Size 116 x 66 x 34mm
- Mouse Driver Software included, allowing you to install with all popular software packages. Also included is the handy Pop-up menu software that allows the user to integrate the mouse with the keyboard, DOS, and other popular software packages

X19950.....$59

COMPUTER CASES



BABY AT* STYLE COMPUTER CASING

Small footprint. Features security key switch, 8 slots and mounting accessories

Size: 360(W) x175(H) x405(D)mm

X11093.....$99

IBM* XT COMPATIBLE CASE WITH AT* STYLING

Features security key switch, 8 slots, and mounting accessories

Size: 490(W) x 145(H) x 400(D)

X11091.....$99

BARGAIN

BARGAIN

FREE.....CATALOGUE NOW AVAILABLE

MAIL ORDER HOTLINE 008 33 5757....TOLL FREE

MOTHERBOARDS

BARGAIN

HS - 3000 HANDY SCANNER

INCLUDES *FREE SOFTWARE!* PC PAINTBRUSH & IMAGE TOOL

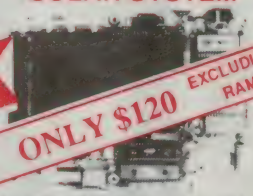
- WIDE 4.13" (105mm) scan width
- 100/200/300/400 switchable DPI resolution.

Four encoded modes: B/W and three half tone patterns.

- Thrity-two shades of grey.
- Built-in scanner view window for accurate scanner placement.

X19945.....$389

THE CHEAPEST XT TURBO MOTHERBOARD IN THE SOLAR SYSTEM



ONLY $120 EXCLUDING RAM

This mighty little XT motherboard has 8 expansion slotsand uses 5 low cost 1MB RAM chips to provide a full 640K memory.

The ASIC chip well known for its reliability is also used.

The CPU is a state- of the art NEC V20 running at 4.7/ 10 MHz (switchable) with zero wait states.

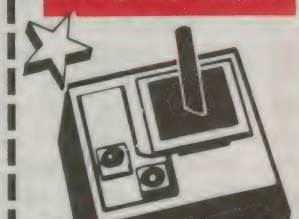
Size is just 208 X 161mm.

"GOOD THINGS COME IN SMALL PACKAGES"

MEMORY SIZE	D RAM
128K bytes	424256 x 1
256K bytes	424256 x 2
384K bytes	424256 x 3
512K bytes	424256 x 4 or 421000 x 4
640K bytes	424256 x 5 or 421000 x 4 + 424256 x 1

CAT X18037

JOYSTICKS



JOYSTICK FOR IBM*

Features selectable "spring centring" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control

C14205.....$49.95

APPLE* COMPATIBLE JOYSTICK

Ideal for games or word processing. Fits most 6502 "compatible" computers.

C14200..... $29.95

BARGAIN

THE FASTEST XT TURBO 31MHz XT MOTHERBOARD

We are offering to you the FASTEST XT on this Planet. It features 31MHz compared to 4.77MHz on the standard XT. The board is fully XT compatible and runs with all standard XT cards. Speed is switchable between standard 4.77MHz and turbo speed.. Up to 1 MB of RAM can be fitted on board . For even faster operation the memory above 640K can be used as "shadow" RAM for speeding up BIOS operations or as a RAM disk. The board provides software selection of wait- state.

X18036...$199

PERFORMANCE INDEX NORTON'S SI, V- 4.0

	1	2	3	4	5	6	7	8	9	10	11
X18036											
IBM XT											
IBM PS2 MODEL 30											
10 MHz XT											
IBM AT											

MAIL ORDER HOTLINE 008 33 5757....TOLL FREE

CHEAPEST EGA CARD IN THE WORLD!

SAVE

For quality and a great price this EGA video card is the cheapest in the world. Using the most advanced paradise chip technology, it provides reliability and maximum performance.

FEATURES INCLUDE:

Full compatibility with XT, AT, 386

Full 256K display memory

Completely backward comp. with CGA, MDA, an. Hercules with intelligent switching software.

480 line extended EGA mode.

ONLY.....$139

088 335757 HOTLINE

NEWS HIGHLIGHTS

TELECOM REPLACES OLD OPTO-MECHANICAL 'SPEAKING CLOCK'

"At the third stroke..." These words have kept Australians on time, and in time, for 35 years. But time has finally run out for Telecom's old 'Speaking Clock'.

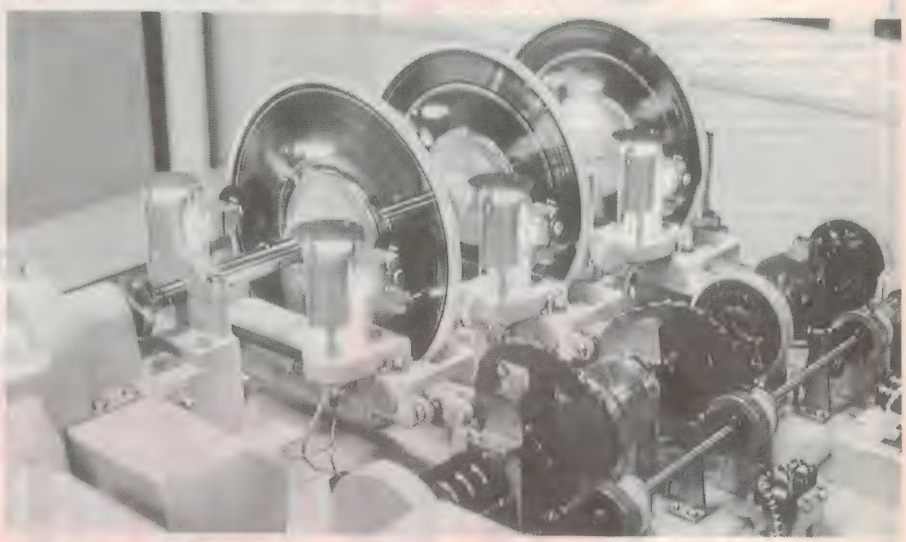
Since its introduction in 1954 *(see R&H, January 1955,)* the Speaking Clock has become Telecom's most popular Dial-It service, with over 50 million calls per year. However, the Speaking Clock's robust electro-mechanical technology is now obsolete and has become difficult and expensive to maintain – a situation that signals the end of its long and remarkable service life.

So now a new Speaking Clock has replaced the old and a comparison of the old and new technologies reveals just how far electronics have advanced in the last three decades.

The old Speaking Clock (originally one each in Melbourne and Sydney) was a technical marvel in its day. It was designed by the British Post Office and consists of a number of rotating glass discs with photographically etched voice tracks. Light beams shine through the voice tracks to 'read' them by photo-detectors and every 10 seconds, a series of mechanical rods and cams direct the light beams to the correct tracks for the next time announcement.

The new Speaking Clock has been developed by the Telecom Research Laboratories in conjunction with a number of Australian firms. It incorporates state of the art speech storage and retrieval techniques combined with microprocessor technology.

A suite of pre-recorded words and phrases were encoded into the computer memory of the clock's announcing unit. The only words and phrases needed for time announcement messages were 'At the third stroke'; 'precisely'; 'o'clock'; 'it will be'; the numbers 1 through 20; and the numbers 30, 40 and 50. Every ten seconds, the announcing unit's computer assembles the appropriate stored words into a time announcement message. A supervisory unit then adds the three strokes, or pips, and the whole message is 'spoken' to callers who have dialled the service.

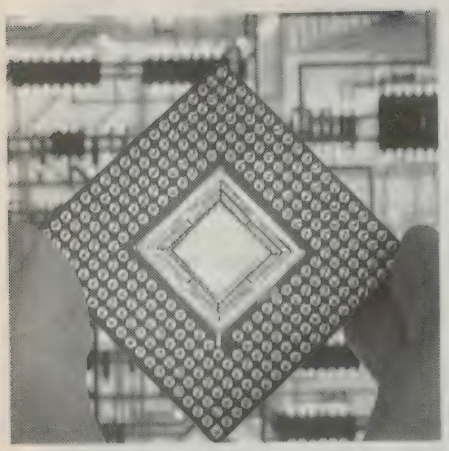


At the heart of the new Speaking Clock are precision oscillators which operate in a similar fashion to a modern quartz watch. However, their frequency is remotely controlled by an atomic resonator device at the Telecom Research Laboratories, which provides a time standard accurate to within one second per 3000 years. The Caesium Beam Frequency Standard is also used by Telecom to efficiently synchronise the transmission of data and voice through its network, and is compared and calibrated against other clocks worldwide to guarantee its accuracy.

The voice of the original Speaking Clock was that of Australian announcer, Gordon Gow, who originally worked for the ABC and had moved to Britain working for the BBC when the announcements were recorded. Now 69 years old, he is still working and can be heard on Sundays as the British correspondent for the 'Showman' program broadcast on ABC radio. The voice for the new Speaking Clock belongs to Adelaide ABC radioman, Richard Peach.

The new Speaking Clock systems are being installed in all Australian capital cities, including Darwin.

FASTEST PABX PROCESSOR CHIP



Engineers and scientists at Ericsson's Design Centre in Broadmeadows, Victoria have achieved a world first in telephone technology. They have developed a new telephone exchange microprocessor which operates three times faster than any other in operation.

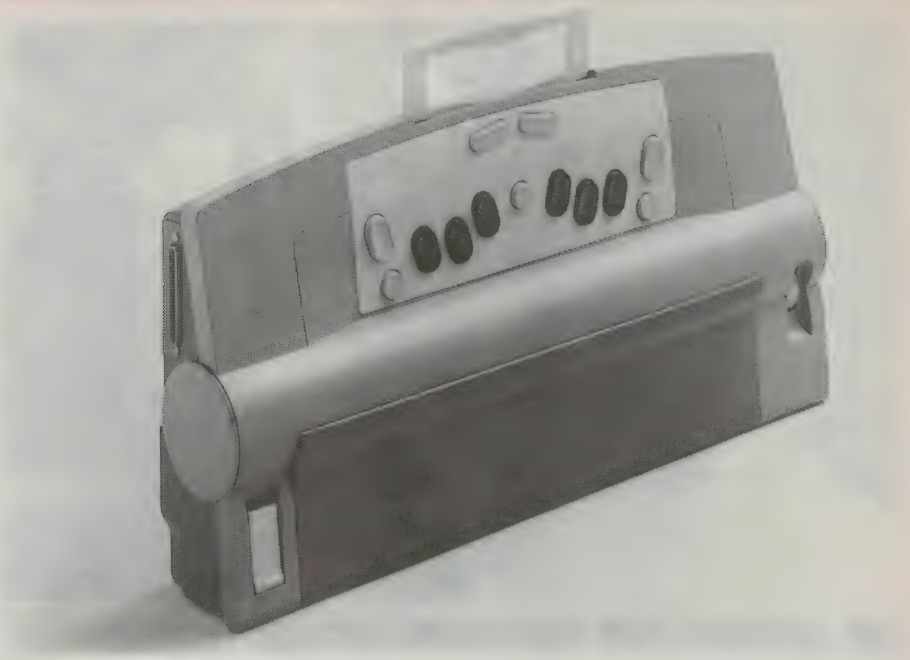
From this year onwards, and for the next five to six years, the microprocessor will control the majority of existing and future AXE exchanges around the world. Ericsson designed and manufactured AXE exchanges operate telephone systems in over 80 countries throughout the world and they are the backbone of Australia's public and cellular mobile telephone networks.

The breakthrough with the new microprocessor has created worldwide interest, with orders already in the pipeline from the United States, Denmark, Sweden and Finland. The first exchange in service is planned for the city of Kolding on the Jutland Peninsula in Denmark.

The new processor is much smaller than its predecessor and can execute its programs 3.5 times faster.

To achieve the breakthrough, Ericsson engineers had to design three chips, each of which contains 100,000 gates.

AUST FIRM PRODUCES FIRST PORTABLE BRAILLER



After World War II when Lord Mountbatten was Viceroy of India, he decided he wanted to make a real contribution to the blind people of that country. This wish was realised by Prince Charles and the other trustees of the Mountbatten Trust which funded the initial research and development of the Mountbatten Brailler. Over $1M in today's money was spent on the original research.

In 1988 Quantum Technology, a small Australian electronics company, won the world-wide licence to product engineer and manufacture the Mountbatten Brailler against strong competition from US and German companies. Instrumental in winning the contract was the tangible support provided by the Royal Blind Society, the Royal Guide Dogs for the Blind and Senator John Button.

Over the next two years Quantum Technology refined and prepared the Mountbatten Brailler for production. Over $1M in funding was supplied jointly by Rene Rivkin's Oilmet Investments, the Commonwealth Development Bank, the Federal Government under the GIRD scheme and the NSW Government under the FIRST scheme.

The Mountbatten Brailler will retail for $2800 and supplants cumbersome equipment costing over $15,000. Initial orders currently exceed $700,000 and within three years Quantum expect to be exporting 5000 units a year.

The final product incorporates sophisticated electronic and software design, exotic materials technology in the braille head, and a sleek injection moulded plastic casing.

The Mountbatten Brailler was also the first joint venture between TAFE and an outside company. TAFE staff and students designed and engineered several key injection moulding tools for the product.

CSIRO DEVELOPS NEW ONE-OHM STANDARD

National Measurement Laboratory scientists have recently developed a standard one-ohm resistor which has generated interest among the world's standards and research laboratories. Four resistors at $15,000 a time have been sold already with orders for another 15 in the pipeline. Negotiations are under way with a scientific instrument company and further sales of around 100 resistors can be expected.

The resistor is made from an alloy known as 'Evanohm S', which has a significantly better performance than resistors made from the more usual Manganin alloy. The peak of the resistance-versus-temperature curve for Evanohm (unlike the Manganin peak) can be moved by heat treatment during manufacture to the normal ambient temperature of the laboratory.

More important, the non-linear contribution to the temperature characteristic is much smaller for Evanohm S than for Manganin and the temperature coefficient is zero near 22.5°C. This means that the value of the resistance is much less dependent on temperature than it is in the case of Manganin types.

The four terminal, self-supporting resistor consists of a helical coil of wire, bifilar wound to minimise inductive effects. Fabrication involves a program of heat soaking at temperatures below 500°C for varying periods. Final resistance adjustments are made using an electrolytic etching technique so that the required specifications are achieved.

NEWS HIGHLIGHTS

ARL DESIGNS ASIC FOR AERONAUTICAL TESTING

Engineers from the Aeronautical Research Laboratory (ARL), using the facilities of the CIMA ASIC Design Laboratory, have been working on the design and manufacture of an Application Specific Integrated Circuit (ASIC) which will literally put them at the leading edge of aeronautic structural testing technology.

Since 1937 ARL has provided essential support to the aircraft industry and is the only major laboratory dedicated to aeronautical research in Australia. ARL is a world leader in full scale structural testing of aircraft and provides expertise and experimental facilities for the static and fatigue testing for the local aircraft industry and armed services. They are currently working on a full scale structural test of the rear fuselage of the FA18 fighter aircraft.

The electronic design team from ARL led by Graeme Burnett and supported by Ian Powlesland, Lee Conder and Steve van der Velden completed the CIMA ASIC Design Workshop, which enabled them to access the workstation facilities of the ASIC Design Lab to perform their designs under the supervision of CIMA's Technical Director, Mike Osborne.

The team has developed a digital service control unit using a transputer as its processor configured in a real time distributed control system. Such an arrangement will allow for 150 controllers to be operated and easily monitored by a PC located adjacent to the test rig. Configuring the system in this manner means that 15 MIPS (millions of instructions per second) of computer power can be distributed to each controller, allowing much greater control bandwidth and more sophisticated adaptive and interactive control algorithms to be implemented.

In designing the digital controller the team decided to implement the digital logic and peripheral interfacing sections into an ASIC. The 12,000 gate, 100-pin ASIC will have a die size of about 8 sq.mm. It will provide a higher packing density and bandwidth, lower power consumption and cost than is available from discrete components.

PHILIPS UPGRADES DIFFUSION LINE AT HENDON PLANT

Philips Components has installed an advanced diffusion line for 3″ silicon wafers at its IC manufacturing plant in Hendon, South Australia, to replace the 2″ line which has operated since 1970. Successful trial runs through the new line have produced samples of Philips' highest demand ICs.

"Our local design engineers can now take immediate advantage of many of the latest IC manufacturing processes as they are developed in Europe", said Hendon factory manager John Ward.

The new wafer technology opens up many advanced processes such as protective glass plating of chips and 'double layer metallisation' – a technique that greatly increases the circuit density, allowing reduction in chip size.

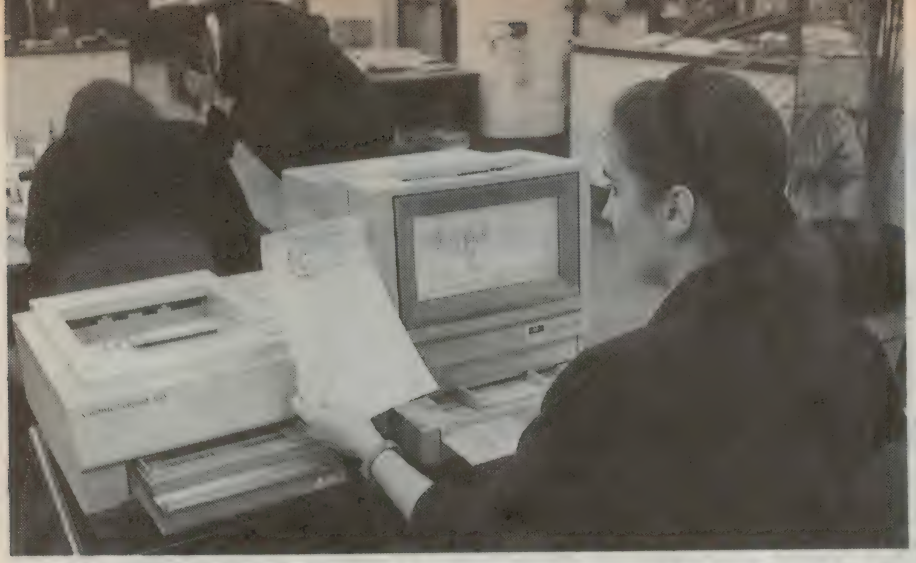
"This is a major upgrade for us and will help to make us even more competitive," said Richard Thode, Philips' Customer Microelectronics business manager, a firm believer in the appropriate level of technology for the local industry and manufacturing environment.

"The new IC line is the most appropriate one for combined custom circuits on a single chip, as typically required by our Australian customers", he added.

Philips' Hendon plant currently employs around 150 highly skilled engineering and manufacturing personnel.

NEWS BRIEFS

- ***Philips Australia, Pacific Company and Imagineering Technology*** have established a strategic alliance, whereby Imagineering will represent and distribute Philips' communications, business and information equipment throughout Australia. Products covered by the alliance include PABX's, professional PC's, cellular mobile terminals and UHF CB radios.
- There has been a management buyout at ***Ericsson Components***, with existing MD Neil McCormick and financial controller Robert Auld now shareholders. The company will continue manufacturing capacitors and marketing its existing range of products, but not as part of the Ericsson group.
- ***Siemens*** is currently negotiating a Partnership for Development Agreement with the Australian Government. The company is tendering for Telecom's rural and metropolitan switch business, and if successful it proposes to undertake manufacture in Australia for world markets. Last year it bought a licence to manufacture the Australian-developed QPSX system.
- Semiconductor and component distributor ***Veltek*** has appointed three new sales people – Igor Karlick in Melbourne, and Karl Sice and Craig Savage in Sydney. The firm has just celebrated its second birthday.
- ***Ericsson Australia*** has been awarded a further $46 million contract by Telecom Australia, to supply ISDN equipment. The contract covers a number of high capacity switches and Primary Rate Access (PRA's) for the network. Most of the equipment will be manufactured at Ericsson's plant in Broadmeadows, Victoria.



The Commonwealth Bank has installed three Canon 'Friday' systems in its Martin Place (Sydney) branch to speed up signature verification on cheques. The new systems use removable magneto-optical disks – each of which holds the equivalent of 12,000 A4 pages of information.

DEVELOPER OF PAL TV DIES

Dr Walter Bruch, the developer of the PAL colour TV system used in Australia and many other countries, passed away in Germany on May 5 this year. He was 82.

Recognised as one of the most creative engineers in the world-wide television industry, Dr Bruch joined the Telefunken firm in 1935. He then designed and built almost the entire TV system used to transmit the Olympic Games from Berlin in the following year, even operating cameras himself.

After the war, Bruch was called back to Telefunken and directed the development of the firm's first postwar TV receiver. He also played a major part in designing and developing the German TV broadcasting systems.

Telefunken established a laboratory for his personal R&D activities in 1959, and it was here that he developed the PAL colour encoding system now used in over 70 countries.

Dr Bruch won many international honours, including the SMPTE's David Sarnoff Gold Medal (1971), Fellowship of the Royal Television Society, the Werner von Siemens Ring (1976) and honorary membership of the British IERE.

- Perth-based test instrument distributor ***Quiptek Australia*** has opened an office in Melbourne, at Suite 66, Sandbelt Motel, 630/646 South Road, Moorabbin 3189. The phone number is (03) 532 1328.
- ANZAC frigate builder ***AMECOM*** has awarded a major subcontract for the ships' command and surveillance systems to Swedish-owned firm Bofors Electronic Pacific. Nearly 70% of the development and manufacture will be done in Australia and New Zealand. Computer Sciences of Australia has also been awarded a $100 million contract to design, develop and install five test and training centres for the combat system to be installed in the frigates.
- Melbourne-based maker of metal cutting laser equipment ***Laser Lab*** has won a $5 million order from West German machine tool distributor Matra-Werke GmbH. The company's new Pentacon product was developed with assistance from a grant by the Industry Research and Development Board.
- PC enhancement board maker ***Hypertec*** has appointed Brian Richards as national marketing manager in Australia. Mr Richards helped develop the company's UK operation.
- Audio, video and data communications equipment maker ***Maser Technology*** has appointed Bob Hammond as National Sales and Marketing Manager. Mr Hammond has held senior positions with 3M, JVC-Hagemeyer, Philips and Racal. Maser has also been appointed Australian distributor for the data analysers and data capture equipment of Alabama-based Hard Engineering Inc.

DOUBLE DESIGN AWARD FOR LOCAL MOBILE RADIO

In June this year the Philips PRM80 series of mobile radios – designed and made at Clayton, Victoria – became the first Australian product to receive one of West Germany's 'Gute Industrie Form' Awards (IF Award). Now the same family of two-way radios also has the Australian Design Award to support its global marketing thrust.

National chief director of the Australian Design Council, Keith Jordon, expressed no surprise that the Australian award comes some months after the presentation in Europe.

"Like all products submitted to the Australian Design Council for assessment, the Philips radio was carefully scrutinised against 43 criteria," said Mr Jordon. "These included manufacturing technology, quality, reliability, ease of handling, functional performance, safety during use and environmental compatibility. Our Award has, arguably, the most stringent criteria in the world today and is renown internationally so we've given this Australian mobile radio a valuable endorsement."

The PRM80 uses surface mount technology for 98% of the components, plus a rugged die-cast chassis for high reliability.

PHILIPS ELECTRONICS FOR CHINA'S TALLEST BUILDING

China's tallest building, the 63-storey Guangdong International Building, will have more than $1.5 million worth of Philips electronic systems installed before it opens early next year.

The building, which will include banking and business facilities, offices, apartments, shops, restaurants, a recreation centre and a 700-room luxury hotel, will become the tallest in the People's Republic. Its facilities will include Philips public address systems; compact disc background music systems, including microprocessor-based routing; almost 200 CCD remotely controlled security cameras; and a mobile radio telephone system. The security TV system will have a microprocessor switching matrix so that the pictures can be routed to pre-selected monitors.

An advanced auto-visual presentation system and a congress system for Phase Two of the project are also being designed by Philips. The main Guangdong building will be connected to two smaller buildings, 30 and 33 storeys high respectively.

When I Think Back...

by Neville Williams

From sparks and arcs to solid state – 2

The relatively crude technology which sufficed for the establishment of wireless telegraphy had to be considerably refined before it could be used for telephony – direct transmission of the human voice or music. Many different arc and spark systems were tried, in an attempt to produce the necessary continuous RF carrier.

As indicated in the previous article, early wireless transmissions comprised a sequence of damped wavetrains, centred broadly on the frequency at which the antenna system and its associated feed circuit happened to be resonant – by chance or intent!

Each wavetrain was initiated by a high amplitude pulse created by the collapsing magnetic field of an induction coil, the recurrence rate being determined by the natural frequency of a 'buzzer' type contact, or a motor-driven switch mechanism or AC generator.

Normally set to a recurrence rate of a few hundred per second, the sequence of wavetrains assumed the character of an homogenous radio signal, coarsely modulated at an audio frequency of a few hundred hertz:

- Amplitude modulated, because each burst of signal or damped waveform tapered from a maximum value to zero. Also:
- Frequency modulated, because each wavetrain varied randomly from others in terms of the phase of the RF component.

For telegraphy, this inherent modulation of the signal was more an advantage than otherwise, being compatible with the then current detectors:

(1) It did not interfere with the ability of a coherer to function as a signal-dependent resistor controlling an external direct current to operate a relay and inker, a galvanometer, a telegraphic sounder or headphones.

(2) It also permitted a rectifier/detector such as a crystal or thermionic diode to demodulate the amplitude component and provide an audio component to feed headphones or (later) an audio amplifier.

Unsuitable for telephony

However, the pulsed nature of the RF signal rendered it unsuitable for simultaneous voice modulation, because the speech would be chopped up at the basic pulse rate. In his book *The Wireless Telephone* (1910-11), the well known technical author/editor Hugo Gernsback described his abortive attempts to modulate an existing spark transmitter. I quote:

The system worked fairly well over small distances but the voice can not be heard at all times, for the reasons explained... Entire words and consonants drop out, as the rate of sparking is far too low. Words containing many vowels are made out best such as : halloh, you, papa, etc. The vowel 'e' is never heard well.

Gernsback outlines various attempts to overcome the problem:

- An arrangement of his own, using multiple induction coils and spark gaps, which would hopefully produce a sequence of wavetrains with fewer interruptions.
- A Fessenden arrangement using what was essentially a capacitive microphone in parallel with the storage capacitor, the idea being that the timing of the sparks might be synchronised to an extent with the inflections of the voice.
- Possible variations of the above, suggested by an experimenter named McCarthy, including one which was effectively a microphone/buzzer combination to create sparks synchronous with the 'sonority' of the voice. Another used an induction coil with twin primaries – one connected to a buzzer, the other to a microphone. A third sought to combine an induction coil with an arc having its supply modulated by a microphone.

After describing still other schemes by Fessenden, Nussbaumer and Bathrick, Gernsback summed up the position as he saw it:

It is almost impossible at the present stage, to transmit the human voice wirelessly by means of the ordinary spark coil, because of the relatively long pauses between the discharges.

Timed sparks

The one scheme which won any commendation at all is as shown in Fig.1. It involves the use of a 3-phase AC supply, preferably from a relatively high frequency alternator, with a step-up transformer from each phase feeding a separate induction coil and spark gap. This could be expected to feed an accurately spaced sequence of sparks to a common antenna circuit with a repetition rate six times the frequency of the alternator.

In his book *Radio Telephony* (Wireless Press, 1918) Professor Alfred N. Goldsmith PhD FIRE AIEE is somewhat less pessimistic about modulating spark transmitters. He pictures a 'timed spark' system which had been developed by the Marconi Company for use in their transatlantic link from Carnarvon in the UK to Marion, Massachusetts USA.

As indicated in the circuit of Fig.2, it involves the use of four 'dischargers' (D1 to D4) mounted on a common motor-driven shaft. Four associated induction coil systems, fed with 10kV DC, are actuated by gap electrodes on the spinning discs, radially staggered so that 16 evenly spaced discharges are pro-

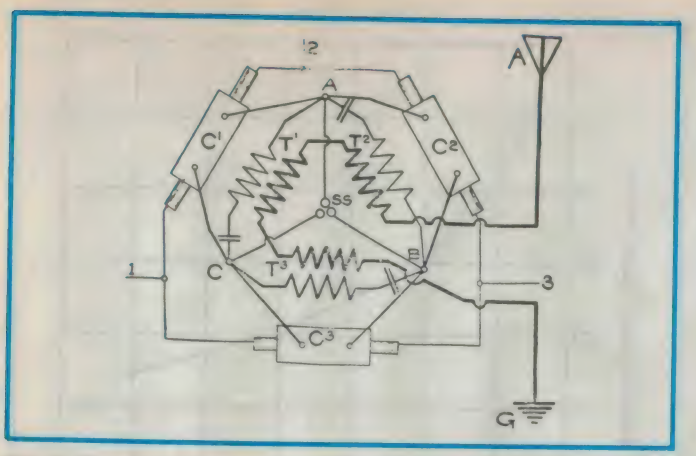


Fig.1: The most promising circuit Hugo Gernsback could come up with in 1911 for a spark type telephony transmitter. It assumes the use of a 3-phase AC supply connected to points 1,2 and 3. T1, T2 and T3 are matched RF transformers feeding the antenna system.

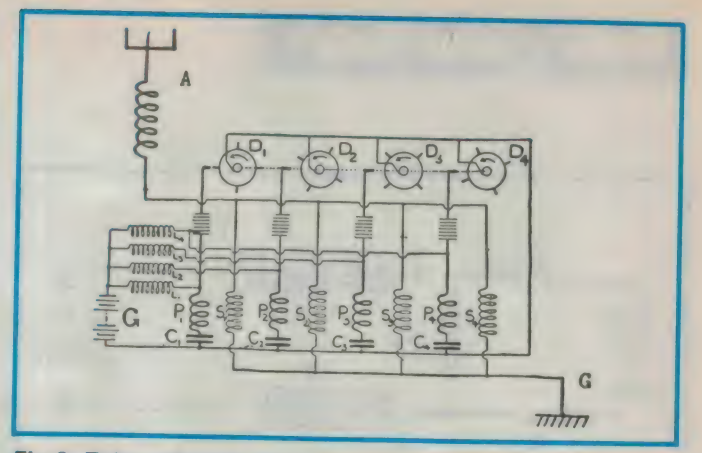


Fig.2: Taken directly from Goldsmith's book, this Marconi discharger operated from 10kV DC and provided 16 evenly spaced discharges per revolution. Optimally adjusted, it was said to have produced something very close to a continuous waveform.

duced per revolution.

By correlating the discharge rate with the nominal carrier frequency, the damped wavetrains can overlap and supplement each other to create what closely resembles a true CW (continuous wave) carrier, as illustrated in Fig.3.

Ironically, the emphasis within the Marconi Company was such that the primary objective in developing the system was to produce the purest possible telegraphy signal, which could be intercepted by a more selective receiver and rendered audible at a distinctive frequency by heterodyne beat reception.

Goldsmith observes that while such transmitters appear to provide a noticeably clean signal well suited to beat reception, 'equipment of this sort has not been used for radio telephony up to the present so far as the author is aware'.

Over and above Marconi's personal lack of enthusiasm for wireless telephony, logic would suggest that, with the technology of the period, it would not have been easy to maintain the spark rate as an accurate sub-multiple of the carrier frequency. In practice, arc systems emerged as the preferred method of generating continuous waves.

Arc transmitters

At first glance, use of an arc may appear to be a simple logical step: to progress from sequential pulses to a continuous signal, one needs only to move from individual sparks to a continuous discharge. In fact, the two are quite different in their mode of operation, as indicated by Goldsmith and discussed at some length in early issues of the *Admiralty Handbook*.

Fig.4, from the 1931 *Handbook*, shows the basic arrangement for a Poulsen type arc, associated with an oscillatory circuit L-C. Inductors L1 and L2 serve to isolate the RF components from the DC supply source and, also tend to limit and regulate the current to the arc system by inductively counteracting short-term variations.

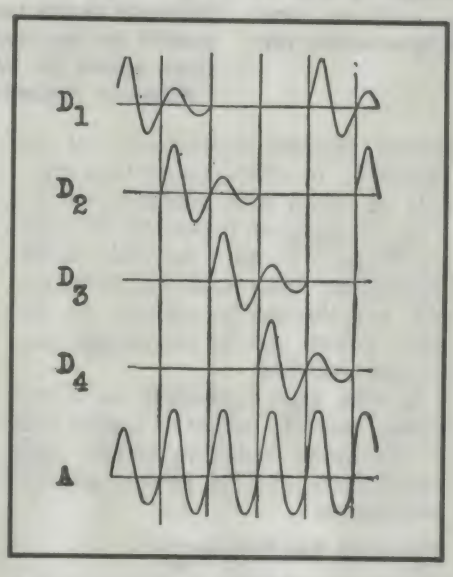


Fig.3: Optimally adjusted, a timed spark system could produce something very close to sustained radiation or a CW signal.

The positive electrode – or anode – is typically of copper, water cooled to prevent overheating. The negative electrode – or cathode – is of carbon, with the surface exposed to the arc operating at white heat. 'X' is a Morse key or key-operated relay, while L and C represent the oscillatory RF output circuit.

At white heat, the surface of the carbon electrode emits free electrons which collide with gas molecules in the gap, creating a conductive path across it; this comprises large numbers of positive and negative ions. In consequence, the conductivity of the arc is, by nature, quite different to that of other conductors.

If one plots the voltage across an arc against the current through it, the result is a curve similar to that shown in Fig.5, which indicates that, as the voltage increases, the current falls – the reverse relationship from that which Ohm's Law predicts for conventional resistive devices. In technical jargon, such an arc is said to exhibit a 'negative' resistance.

Arc-driven oscillators

In the context of oscillatory circuits, we have already seen that ordinary (positive) resistive loss or loading causes an oscillatory waveform to die away over a few cycles, resulting in a damped wavetrain. The less severe the loading, the longer does the wavetrain persist; in an ideal lossless, non-loaded circuit, the oscillation would continue indefinitely.

Not surprisingly, when a practical (less than ideal) tuned circuit is shunted by a *negative* resistance device, oscillation, once started, will continue indefinitely – providing the negative resistance is sufficient to cancel out the effect of the 'positive' losses and loading.

Consider again Fig.4. When the key is closed, capacitor C begins to charge through inductor L towards the arc voltage. Because L1 and L2 hold the total current 'I' constant in the short term, the charging current 'i' is subtracted from 'I' causing an instananeous reduction in the arc current 'i_a'. But because the arc behaves as a negative resistance, this will initiate an upward pulse in arc voltage, thereby supplementing the original positive pulse across 'C'.

At the end of this half-cycle, when the voltage across C begins to diminish,

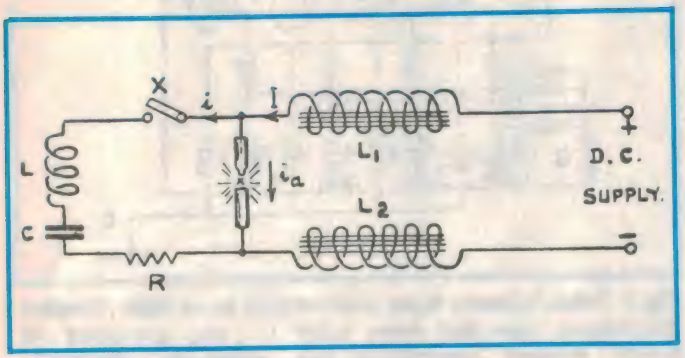


Fig.4: The basic circuit for a Poulsen arc type oscillatory system. Water cooling, a rotating cathode and hydrogenous vapour helped extend the operational life of the arc.

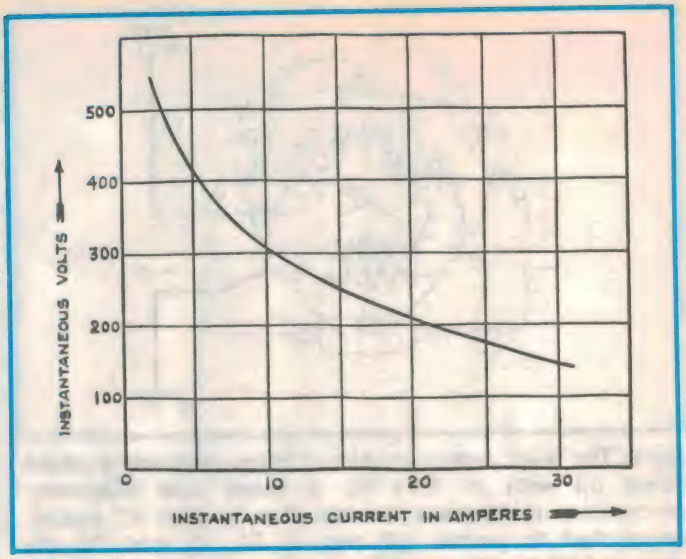


Fig.5: The volt-ampere curve for a Poulsen arc, as depicted in the 1931 Admiralty Handbook. As the voltage across the arc rises from 140V to 500V, the current falls from about 30 to 3 amps, by reason of its 'negative resistance' characteristic.

the discharge current 'i' adds to 'I', increasing the instantaneous value of 'I_a' and reducing the voltage across the arc, this time supplementing the negative half-cycle.

In other words, the effect of the negative resistance arc is to supplement the natural charge/discharge cycles of capacitor C. In effect, rather than dissipate the energy in the oscillatory circuit, it diverts energy to it from the DC supply. Properly set up, it can make up for the inherent losses in the oscillatory circuit and the energy radiated by the aerial system, thereby maintaining continuous oscillation.

As with spark equipment, arc transmitters were the subject of a great deal of experiment and development, both electrical and in terms of their physical presentation.

Typical technology

Poulsen's basic arc was housed in a heavy metal box with the elements mounted on large porcelain insulators to ensure mechanical stability. The carbon cathode, itself, was rotated slowly by means of an auxiliary motor to ensure that it burnt evenly, rather than at one particular spot on its surface.

In addition, it was operated in a hydrogenous vapour – commonly provided by a drip system dispensing alcohol or methylated spirit into the chamber, where it was vapourised by the heat.

The copper anode was cooled by water pumped through internal holes, with water cooling being provided also for the walls of the metal case, depending on the rating – and the heat output – of the particular arc. The cooling water needed to be pure, to avoid the risk of conductive losses.

L1 and L2 were supplemented by – or re-designed to double as – electromagnetic field coils, placed on either side of the arc. The purpose of the field was to bow the arc upward and confine it to the top of the gap, thereby stabilising it by minimising any tendency to flicker from point to point. As a bonus, being dependent on the arc current, the magnetic field could also make the arc simpler to set up and maintain.

Beyond that again, the *Admiralty Handbook* points out that adjustment of the magnetic field allowed the Poulsen arc to function in the so-called 'Beta' mode, in which the arc actually extinguishes for a brief period during the high voltage peak of each cycle, due to diminished current. In this mode the RF system reaches peak efficiency because the total supply current was available to charge the storage capacitance of the aerial system – on a once-per-cycle basis.

There is much more to it, but the purpose of this article is to offer an historical overview rather than a detailed study of arc technology. Sufficient to say that Goldsmith's book, mentioned earlier depicts a variety of arc-driven oscillators current in 1918, all looking externally quite different e.g: Berliner-Poulsen (of various ratings), Danish Poulsen, Lorenz-Poulsen, Continental Syndicate Poulsen, Federal Telegraph Co (60kW and 100kW), and Telefunken.

In the third of these articles we will look at the 'RF alternator' technique, which also had a brief period of popularity, and then at the way thermionic valves were used for the first really successful approach to radio telephony.

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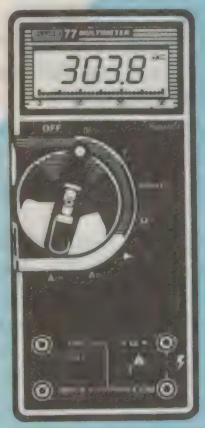

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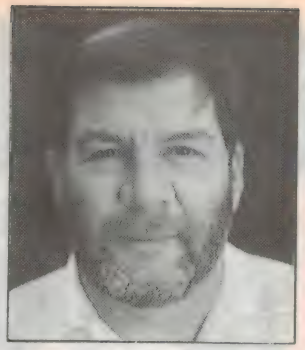
Moffat's Madhouse...

by TOM MOFFAT



Pleased to meet you!

You've got this far? Good. That means that at least one person has started to read *EA*'s new column. Now all we have to do is keep your interest. Shouldn't be hard, though, because this column is going to be 'different'. Yes, I know, they all say that - but just you wait and see!

How did this come about? Well, Tom Moffat is a writer, and Tom needs money. Tom has learned that the average writer in Australia makes something like $10,800 a year. Tom says he and his family can't live on that (no way!) and Tom threatens to chuck the whole thing in and get a 'real' job.

Jim Rowe comes to the rescue. He wouldn't want to see Tom have to turn up for work every day, or wear a suit and tie, or do any of those other nasty 'civilised' things, just to earn a crust. Tom's not into offices at the moment; most of his work is churned out on a laptop computer, sitting in front of a warm fire, or on the beach. Last summer Tom went for 11 straight working days without once putting on a pair of shoes.

"How would you like to write a column?", says Jim. "About what?", says Tom. Well, I don't think we ever sorted that out completely, so I guess the column can be about almost anything providing it has *something* to do with electronics.

Who's all this aimed at? Hopefully, young people, just starting out in their careers. And older people, who remember all the hassles, and the fun. I intend to pick a lot of people's brains for material; remember Grote Reber, the radio pioneer? *EA* ran a story of mine on him a while back. Now there is a man of immense wisdom — the kind of guy who can contribute a lot of knowledge and commonsense. We need more like him.

You're also going to get a lot of the thoughts and opinions of Tom Moffat. Oh, no! YES! I've done my time as an unbiassed reporter of other people's actions and ideas. So I reckon I've earned the right to unleash some one-eyed, opinionated, hypocritical drivel on you. You may shriek with horror - he's WRONG! Then again, I may be right, too. Those television current affairs people can get away with it, why can't I?

Talking shop

Right, time to get serious; about education, and jobs. I'd like you to join me on a brief trip back through time, to the USA, the country where I was manufactured. Grade 7, Woodrow Wilson Junior High School, Albuquerque, New Mexico. There were no 'optional lines of study' back then. Everyone in the school did the same subjects, with one exception. Girls all did home economics, and boys did a course known as 'shop'.

When I went home after the first day of Grade 7, I told my mother I was enrolled in 'shop'. She threw a fit: "What do you mean, taking SHOP! We're raising you to be an engineer, not a fitter and turner!"

Ah, Mum, there was no choice... I had to take shop... I know it's a letdown, but I'll struggle through.

I never let on to Mum, but I *loved* shop. There was this big long room with windows all down one side to let in plenty of light. Near the windows was a line of lathes, and then drill presses, and a couple of milling machines. There were big sturdy workbenches, each one with its own vice, and on the walls were boards holding hacksaws and files of all descriptions.

What we did in shop was make things. We were taught to use the proper sized screwdriver for the screw in question. We were taught that you let up the pressure during the backstroke of a file or hacksaw. We learned that you could wreck a drill bit quick-smart if you selected the wrong speed on the drill press. We learned that you'd better have your goggles on when using the bench grinder. We were taught oxy-acetylene welding. And best of all, we learned to use those lathes.

The shop teacher was a perfectionist, to the extent that he was a real pain in the rear. Is your work-piece out of tolerance? Do it again. You scratched that bit of steel with the edge of the file? Start over. Although we didn't realise it at the time, that shop teacher was teaching us one of life's major truths: sub-standard work should be rejected.

My major project that year was to make a G-clamp. The body was carefully cut out of a thick chunk of steel plate and then shaped up on the milling machine. Every tolerance had to be 'just so', within a couple of thousandths of an inch of spec (no millimetres in those days). The part you hung onto was carefully knurled to provide a better grip, and then the whole clamp body was worked over with a bit of steel wool spun in the drill press to give it sort of a circular sheen.

The screw part was made on the lathe, by carefully manipulating the controls by hand. If the tool dug in, the screw broke, and you had to start over. After half a dozen goes I finally got the screw finished, within tolerance, and it was a big moment when I finally screwed it into the clamp's body. The thing shone in the light of the window, and it reeked of cutting oil. I was so proud of it! That was the name of the game, I guess, pride in a good job. Even Mum thought the clamp was 'nice'.

I eventually ended up in electronics, not a fitter and turner. But was the time spent in 'shop' wasted? Not on your Nellie! Time and again, when I design things, I need to fit them into a case, or attach a solenoid to this or that, or arrange a stepper motor to turn a gear to move an arm or whatever. It isn't often I actually get to make these things myself, but at least I know how it's done. The sad thing is, I think many engineers and technicians these days are missing out on this knowledge.

How many of you have been working in an R&D lab or workshop, when the fellow next to you puts a piece of aluminium in a vice and rips into it with

a file, leaning into it as hard as he can? He's soon got a clogged up, dull file. Nobody's ever shown these people how to use a file properly, or even the correct terminology... I once asked a young tech to 'hand me that flat bastard file over there' and he thought I was swearing!

That's minor stuff, it gets worse the higher up you go. A few years back I was asked to take part in a project to 'commercialise' a scientific instrument developed by a team led by Doctor X at a well known university. 'Commercialise' in this sense means to make the prototype into something manufacturable. I can't go into any detail about this gadget, because I was made to sign a non-disclosure agreement before being allowed to even look at it. It's sufficient to know the device was mostly electronic, except for a detector head that had to be machined.

What a shemozzle! It soon became evident that the 'expert' designers of this instrument had done things like specifying 15- volt power transistors in an 18-volt circuit. The prototype worked, but only by sheer good fortune. As for the detector head, the designers were certainly going for accuracy. The drawings said it to be machined to an accuracy of some tiny fraction of a millimetre.

My own limited 'shop' training told me the detector head would be a mighty hard job, so I took the precaution of consulting with the precision instrument maker who had been chosen to machine it. He took one look at the drawings and said it simply couldn't be done. The only way such accuracy could be approached would be in a clean-room or in a vacuum, and such a device would cost thousands, or tens of thousands, to make. All this for a product with a target price of around $4000.

The manufacture of this instrument was being promoted by a government department, and many of its 'experts' had studied the design. Other 'experts' in the university had also gone over it, and a commercial company was ready to market the finished product. One wonders how a device that was virtually unmanufacturable had managed to slip past all of them, only to be picked up by some guy who'd done a 'useless' shop course in Grade 7. At last report the project had gone into abeyance, on hold, back to the drawing board.

Instruments like that were designed by committee, and maybe nobody took the overall responsibility to ask if the thing was really practical. Nowadays, with the economy retracting and staff numbers being 'rationalised', many new products are going to be designed by one or two people at the most, in kind of a 'cottage industry' situation. What they can't do themselves they'll have to contract out, but if the designers know how to do their own machine work, or plastic fabrication, they'll save a lot of money. Will today's students be taught these skills?

Back to the domestic scene... my teenage daughter has gone to a social at Newtown Boys High School in Hobart. I'm waiting to pick her up. It's after midnight and I'm getting bored, so I decide to walk around the school grounds, peeking in windows, to kill some time. I soon come to a big bank of windows, the whole wall of a long room. Inside I see — a step into the past. It's Woodrow Wilson Junior High School as I knew it in Grade 7.

There are lathes, and workbenches, and screwdrivers and files and hacksaws, and a milling machine, and the smell of cutting oil wafting through a vent. The equipment is old; it looks exactly like the stuff I learned on. The scene is just like one of those time-warp movies where you slip back to your high-school days, like 'Peggy Sue Got Married'. In just a blink I see myself standing there with my G-clamp.

Next year my son is to enter Grade 7. With that vision of the 'shop' room, and all the advantages it's brought me over the years, I put it to my wife: "Let's send Steven to Newtown".

"What do you want him to be?", she says. "A fitter and turner? I thought we were raising him to be an engineer!"

To cut a long story short, we went to have a proper look, and to talk with the principal. In the past the school was certainly 'for the trades', but nowadays it's recognised as one of the best around for maths, science, and even music. This school, and hopefully many more like it in Australia, is combining theory with the ability to get one's hands dirty.

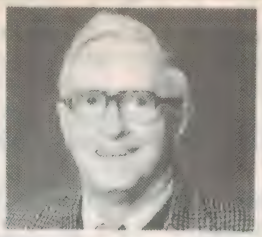
Most of the gear in the machine shop is pretty ancient; but a small business will likely be using a beat-up old lathe bought at auction. So our new engineer/technologist will be on familiar ground.

Newtown has a computer lathe as well. These kids, if they choose it, will also be trained in plastic work (just try to develop a commercial electronic product without plastics!) and they'll also learn other skills such as welding.

It's a rough-and-tumble old world out there, and many people who were working as fully employed engineers 10 years ago are suddenly finding themselves in involuntary self-employment. Some, I suppose, wind up on the dole, but others who have the skills to do things for themselves are discovering a new and eminently more desirable way of life. And they don't even have to wear shoes!

SHORTWAVE LISTENING

by Arthur Cushen



The need for frequency allocations and band monitoring

In this second introductory item for the newcomer to shortwave listening, we explain why co-ordination and co-operation are necessary in allocating frequencies and transmission times to the world's international broadcasters.

The shortwave listener is well aware that there are more stations on the bands than frequencies available, and some co-ordination in the sharing of frequencies is essential to enable them to enjoy clear reception of international stations.

In the past, international broadcasters have submitted their plans for operation six months in advance, four times a year, to the International Telecommunications Union International Frequency Registration Board in Geneva, which attempts to solve the jigsaw of who is to use which channel at what time.

Of course, a satisfactory solution is not always possible. Some countries do not adhere to the plan they put forward and therefore interference is a major problem in shortwave listening today. There has also been a reduction in the times of frequency changes and most northern hemisphere countries make frequency changes when they begin summer time at the end of March and revert to standard time at the end of September.

In order to smooth out the problems, several European broadcasters, as well as the Voice of America and Radio Canada, meet in advance of the IFRB meeting in Geneva and try to collate their frequency usage into a well presented format. The ideal situation is, for instance, on 17820kHz when Canada closes at 2200 UTC, the Voice of America opens and so on, so that this particular frequency is used to its potential.

When putting forward their plan many stations are also looking at the possibilities of special broadcasts, when they may require an additional frequency. As well as the IFRB allocations they can look at the various schedules received from stations which are published after the plan is produced, and in the final move, call on monitors in various parts of the world to check the frequency and ensure that it is suitable for a transmission.

This is where monitors like the writer check BBC, Voice of America or Radio Canada International channels on a daily basis, making over 200 observations each day on the signals from these broadcasting services.

As well, each month the writer undertakes a band survey for Radio Canada, in which a nominated band and a time period is surveyed – say, between 0300-0600 for the 25 metre band. During the designated time period the band is surveyed and for each frequency any active station's length of transmission,

AROUND THE WORLD

COSTA RICA: Spanish National Radio, Madrid has been discussing with Costa Rica for several years the construction of a relay station. The first area on which the transmitters were to be located was not technically suitable, but now the land granted by Costa Rica has proved acceptable and the three 100kW transmitters are being installed. The relay station could begin broadcasting towards the end of this year. They will serve the southern part of the United States, Central America, the Caribbean and the northern part of South America – carrying programmes from Madrid.

Radio Impacto which was well received in the South Pacific on 5030 or 6150kHz has closed down, according to a BBC report. The report indicated that the station had closed because it had fulfilled its objective of supporting opposition movements in Panama and Nicaragua.

GREECE: Athens has a broadcast in English to Australia Monday-Saturday 0840-0850UTC. Reception is best on 17535kHz. The transmission is actually 0800-0850, the balance of the broadcast being in Greek.

ISRAEL: Jerusalem, using 17545 with a Home Service Programme ahs been heard around 0500. The programme includes spoken material and many commercials.

PERU: A new station Radio Cora, broadcasting from Lima has been heard on 4915kHz from 0930UTC. The transmission consists of music with announcements by a woman who gives the time and station slogan up to 1000UTC, when full sign-on announcement is given. Reference is made to the mediumwave frequency of 600kHz and signals have been heard past 1100UTC.

RWANDA: The Deutsche Wells relay station in Kigali has been granted a further 20-year extension of their licence. The new contract provides for the two present 250kW transmitters to be replaced and the relay station to be extended and modernised, to four shortwave transmitters of 300kW each.

SRI LANKA: Work is continuing on the construction of new shortwave transmission facilities at Ekala, 30km northeast of Colombo in Sri Lanka. The project is being built with the assistance of Overseas Development Aid from the Japanese Government and will include two 300kW transmitters which will belong to the Sri Lanka Broadcasting Corporation. Radio Japan will lease the transmitters for 10 hours daily to carry broadcasts to India and the Middle East, and operation could commence in January, 1991.

USSR: Broadcasts from several USSR Republics are now received with their own programmes in English. Armenia has been heard on 13645kHz with English at 0250 but the best frequency is 11790kHz. Lithuania has a broadcast in English 2200-2230UTC with 15485 providing the best reception, while other frequency 11790, 13645 and 15455kHz also carry this English broadcast.

YEMEN: Since the joining together of the two Yemeni republics the two respective radio stations, in San'a and Aden have been announcing themselves as the 'Republic of Yemen Radio'. The radio in Aden continues to operate, as yet separately, on 5970 and 11-88kHz, while that in San'a, the capital of the new Republic of Yemen, is heard on 97-80kHz.

signal level and identification is listed. So that at a glance, RCI engineers know what frequencies are being used by other broadcasters and at what strength – and what frequencies are left vacant. This is a practical exercise on frequency usage, and is not like the IFRB plan – which is based on theory and on what stations plan to use. Many times when listening, these proposals are found not to be implemented.

For the shortwave listener the whole exercise is to try and get a signal – for instance, from the BBC – as clearly as possible into their receiver, and by juggling times and frequencies this can often be accomplished.

When stations move frequencies there is a lot of background information obtained before such a change is made; but as it is a free-for-all, most stations try to retain their long established channels so that they can be found on the shortwave dial more easily by their listeners. A change of frequency means a break with their audience, who have to look for their new broadcasting outlet as communication between international broadcasters and their listeners is only through the issue of their schedule of transmissions.

New Zealand's voice

Radio New Zealand International was opened on January 24, 1990 with its new 100kW transmitter located at Rangitaiki, east of Taupo in the centre of the North Island.

For more than 40 years New Zealand's shortwave service had operated with two 7.5kW transmitters located at Titahi Bay near Wellington. These were officially opened on September 26, 1948, but over the years the efficiency of the transmitters declined and the Government decided to take the operation and put it under the Minister of External Affairs.

Some $3M was paid for the transmitter aerials and other facilities, and the remote link to Broadcasting House in Wellington. The service during our morning and evening periods is aimed at listeners in the Pacific, and broadcasts in the many languages of that area.

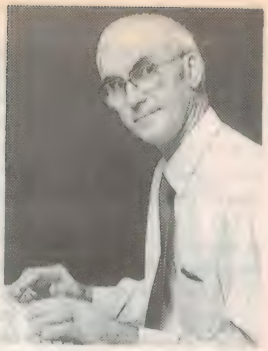
The station is operating for more than 14 hours daily, and 6 hours of this is a relay of the internal National Radio. New Zealand moves to Daylight time on October 7, and this schedule is effective up to that date. After that the broadcasts will be heard one hour earlier in Australia. The schedule is: 1745-2205UTC except Saturday/Sunday 15485kHz; 2205-0000 except Saturday 17675;0000-0710 except Saturday/Sunday 17675; 0710-0830 except Saturday/Sunday 9855; 0000-0645 Saturday 17675; 0645-1100 Saturday 9855; 0200-0800 Sunday 17675; 1845-2205 Sunday 15485.

The transmitter building and towers of Radio New Zealand International at Rangitaiki. The building houses a 100kW transmitter.

This column is contributed by Arthur Cushen, 212 Earn St, Invercargill, New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT), which is 10 hours behind Australian Eastern Standard Time.

FORUM

Conducted by Jim Rowe



The earth-leakage letter avalanche — or Plumber, hold that bathplug chain!

Boy — did I ever get a response to the August column topic, on earth-leakage circuit breakers, and their ability (or otherwise) to protect against the risk of a shock in the bath! No sooner had the issue been published than the letters began to arrive. But then, I *did* ask for your views and comments on the subject, didn't I?

I suppose I shouldn't have been all that surprised at the response, of course. Electrical safety topics are always of great interest, because they affect all of us — and our loved ones. All the same, the response to the August column was particularly strong and *fast*.

Obviously quite a few people felt so strongly about the topic that they dropped everything and dashed off a letter, as soon as they finished reading the column. That's great, folks, and before I go any further, my sincere thanks to everyone concerned for your obvious interest, sincerity and involvement.

My problem now is to deal with all of the letters here, in a fair and equitable fashion. There are so many of them, and some of them are so long, that Forum would have to be enlarged to an enormous size if I were to do them all justice!

Instead, I'm proposing to tackle it another way. First of all, many of the people who wrote made a number of very similar points — so perhaps it's best to give these in summary form, before going too far. Then I propose to extract sections of particular interest and relevance from a reasonable number of the letters, to flesh things out. I only hope that those who *don't* get an extract published don't get offended — just about everyone made some interesting and relevant comments, but there simply isn't room to reproduce them all here.

Before I start, though, I had better quote from one particular letter that arrived from a Mr Chris Hackett of Hastings, Victoria. Although many other readers made critical comments about certain particular points discussed in the column, Mr Hackett seemed to be most irate about us (a) publishing Jeff Thomas's letter, and (b) having had the temerity to comment on the topic at all. Here are some extracts from *his* letter:

I am greatly distressed by the increasing frequency that the 'professional' people in Australia display their ignorance! Your printing and support of Mr Jeff Thomas' letter is inexcusable. Surely you and/or your support staff should have enough intelligence, or access to people of intelligence, to see the total fallacy in Mr Thomas' argument.

For a person to suffer electrocution, they must be present in an electric field sufficiently strong enough to induce currents (nominally in excess of 10mA) through the TRUNK of their body. In the case of the hair dryer in the bath, there would be a sufficiently strong field between the active and neutral conductors WITHIN the hair dryer. But it is inconceivable that anyone could impose themselves into this field, to cause electrocution.

If, AND ONLY IF, there was a path to earth through the water would a dangerous electric field be created. And this earth current is the reason ELCBs are effective.

The only situation where an ELCB would not offer protection is that where the individual contacted the active with one extremity (say the left hand) and the neutral with another extremity (say the right hand). I'm sure that even your 'professional' staff can see the probability is VERY LOW that the average person will ever encounter this situation, double insulation or not. Certainly the greatest probability of any dangerous contact would be between active and some earth plane.

You would have done a greater community service to use Mr Thomas' decorative chain to pull the plug on his letter!

Mr Hackett then goes on to make various 'suggestions' as to what I should do, to 'rectify some of the community damage your irresponsible publishing has done'. As you can see he was pretty upset, and apparently couldn't resist the temptation to become somewhat abusive.

Incidentally among his suggestions, regarding things I could do to make amends for my 'irresponsibility', was that we should solicit and publish information from ELCB designers, testers and manufacturers about the different types of ELCBs, their protection limits and their reliability. He noted, for example, that the Clipsal 4EL series was 'totally magnetic' in operation, while the 25EL30 series from the same maker employed a power supply, electronic amplifier and electro-mechanical release.

It's a good suggestion, and as it happens we don't have to solicit at least some of the information; it has already been offered, as you'll see soon.

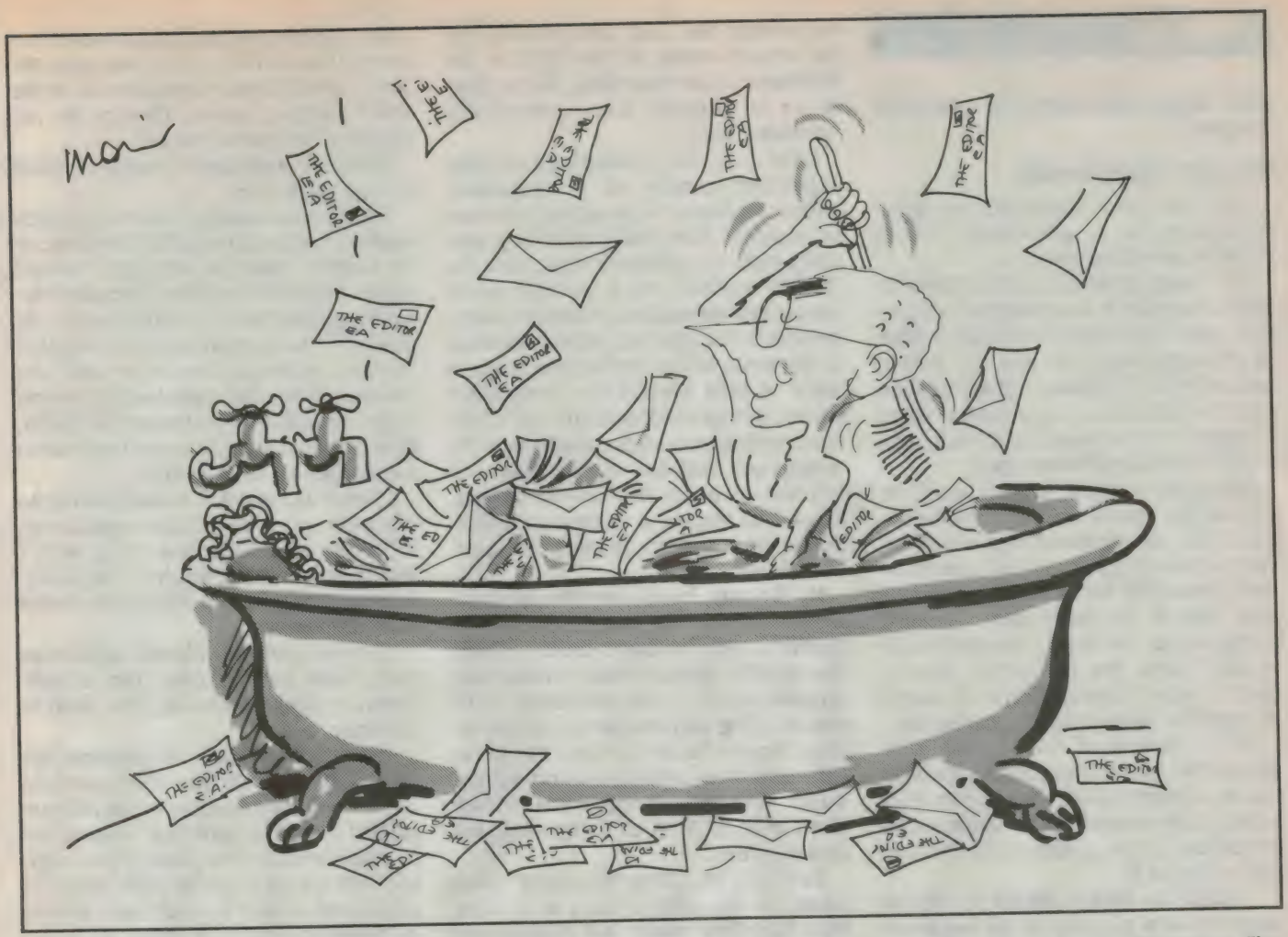
About the only information that *hasn't* been sent in is data on the comparative performance and reliability of the various kinds of ELCB. I agree that this would be very interesting — yet I suspect the ELCB makers aren't going to be too eager to provide it. Perhaps someone else will, though.

General points

Now to attempt that summary of the points made by other correspondents. Probably the specific point most often raised was that expressed rather forcefully in Mr Hackett's letter: a doubt that a hair dryer or similar appliance, dropped into a tub of water, could produce an electric field which extends far enough away from the appliance itself — in the absence of a separate path to earth — to cause a dangerous shock.

This point was raised by most of the correspondents, and it's obviously a crucial one. If the field doesn't extend out far enough to cause a risk of serious shock, with an insulated bath, then it would appear that we don't have a problem; so we can't blame the ELCB for not solving it...

The next most commonly made point was a strong doubt that Jeff Thomas's



suggested solution (fitting an earthing chain to the bathplug) was a satisfactory one. As various readers pointed out, fitting such a chain not only ensures that a significant earth current *will* flow — should something like a hair dryer fall in the bath; it also significantly increases the risk that such a current will flow *through* the bath's occupant. And although this current *should* trip off the ELCB within a few tens of milliseconds, there's the possibility that the bather may have been subjected to a serious — possibly even fatal — shock in the meantime.

A number of readers even suggested that relying on an ELCB to cut off the supply in such a situation would be dangerous, because they allege that earlier models of these devices were 'notoriously unreliable'. They also noted that even the latest models had labels stressing that they should be tested regularly...

In short, the suggestion made by many is that Jeff Thomas's suggested 'solution' of an earthed bathplug chain may in fact *increase* the risk of serious shock, rather than reduce it. Or perhaps even further, that his remedy may even create a risk of shock, where none might previously exist.

The third and fourth points made by many of the correspondents were basically endorsing the comments I made myself in the original column, about (a) ELCB's being a very worthwhile contribution to electrical safety, despite any possible limitations they may have; and (b) the very high risk of using electrical equipment in bathrooms, and the inherent difficulty (impossibility?) in ensuring complete safety if the user insists on using them therein.

Incidentally before we look at some of the specific comments made by readers, to flesh out these points, I'd like to stress again my own strong endorsement of these last two points. As I said in the August column, I believe one should avoid using any portable electrical appliances in a bathroom when anyone is in the bath - it's just too risky. And as I also said in the same column, there are likely to be many situations where a faulty appliance or accident could cause you or your loved ones to become connected between the 240V and earth - and in such situations an ELCB may well save a life. So in my opinion, they're well worth having.

Bearing in mind my comments along these lines in the August discussion, I'm puzzled that Mr Hackett still believed that I was being 'irresponsible'. One hesitates to think what he would have written if I *hadn't* made my position fairly clear...

One further point. I have to confess that when Jeff Thomas's letter first arrived, I *did* have some difficulty myself in understanding/explaining how a hair dryer or similar appliance, dropped into an insulated tub of water, could result in an intense electric field extending far enough outward through the water to cause shock to a person sitting in the tub. However Jeff Thomas's letter suggested that this could perhaps occur, at least to an extent sufficient to pose a risk when you consider the much lower surface resistance of a human body immersed in water.

In any case, because his letter raised interesting points about the way ELCB's operate, and their dependance upon the existance of a leakage current to earth, I decided that his letter was well worth publishing and discussing. Frankly I still don't believe that doing this was being irresponsible — we're talking here about an interesting technical aspect of electrical safety, after all, not a tenet of reli-

gious dogma that mustn't be queried or discussed.

Reader comments

OK, then. Let's look at the way some of these points — and others — were made by individual readers.

Mr Joseph Bonnici of Blair Athol in South Australia is an automotive electrician, and wrote that from his knowledge of electrical theory, he was at a loss to understand Jeff Thomas's claim that if a double-insulated appliance were dropped into an unearthed bath, this would be lethal to the occupant:

Surely this wouldn't happen, as all the current flow would be from active to neutral inside the appliance and would not venture out of it. The path of least resistance would be between the two terminals 1cm or so apart, and not via a person about 1m away. True the ELCB wouldn't trip, but the circuit fuse or breaker would overload, due to excess current flow between active and neutral.

Mr F. Gotsen of Hall in the ACT echoed the same basic doubt, stressing that he offered it with some temerity as he isn't either a professional engineer, an electrician or an electrical contractor. But, as he put it:

...unless the bather should be able to swim between the pins of an immersed 'hissing and crackling' bayonet fitting or inside the appliance, then fatality would seem improbable.

Reference to an 'intense electric field in the water' misses the point that it is localised and may not cause sufficient current to flow outside its 'close' domain to cause fatalities. Perhaps some measurements could be offered to support the assertion.

Apart from this aspect, I found the article very interesting. And even though I would conclude that ELCB's are safer that postulated, I would never consider using any appliances in or too near a bath regardless. But I would not see the need for 'bath earthing chains', nor modifications to double-insulated appliances.

As you can see, Mr Gotsen has perceived the crux of the matter quite clearly, despite his professed lack of relevant 'qualifications'. His suggestion regarding the need for measurements also seems a very pertinent and constructive one. Instead of either making assumptions, as we were perhaps guilty of doing in August, or be like Mr Hackett and summarily dismiss the whole possibility of shock as 'inconceivable', it would surely be prudent to set up a suitable experiment and take measurements of the actual extent of the field in the bathwater when something like a hairdryer is dropped into a nominally 'insulated' bath.

Mind you, this wouldn't be an easy experiment to carry out — particularly with due safety — in an ordinary domestic situation. It probably calls for a specially-built experimental setup, with the 'mains' isolated via a suitable transformer and instruments to measure short-term field strengths and current densities in the water, before the fuses or breakers blow. A little beyond the average *EA* reader, perhaps; but hopefully one of our more professional readers might have the appropriate facilities, and the time and interest to make the measurements. They'd be making a valuable contribution to what is surely an important question of safety.

By the way, I probably should stress here that no-one should even ATTEMPT such an experiment without the right facilities, to ensure maximum possible safety. I am definitely NOT encouraging any reader to try dropping Mum's hairdryer into the bathtub, and then probe around in the water with their trusty DVM. Please don't even THINK of doing anything so dangerous.

To move on, some interesting comments on the subject came in a letter from long-time reader and professional engineer Alan Fowler, of Balwyn in Victoria. In previous discussions Alan's powers of critical and objective analysis have made a very constructive contribution, and that's the case here too. Here are some extracts from his letter, revealing his usual good humour:

If that really is you sitting in the bath, in Alan Moir's cartoon, I hope those are plastic chains tying everything to earth. I agree wholeheartedly with nearly every point that Mr Thomas makes in his letter; however I have the feeling that there is a fatal flaw in one of his arguments.

Perhaps I've got a mental block, but if the situation with the bath and the hairdryer is exactly as he describes, I cannot see why there would be 'quite an intense electric field in the water, (and) a considerable amount of current would start flowing through the person, causing electrocution'.

Before any current can flow through a conductor, there has to be a potential gradient along it. I would expect the 'strong electric field' to be confined to a very limited space, because of the small distance between the ends of the exposed heating element in the drier. If there is no contact between the bath and ground then it, and its contents, would be at some uniform intermediate potential between 0 and 240V AC. In that case the only current flowing would be due to the small charging current through the capacity of the bath to ground.

Until the unfortunate bather touched the tap - then ZAP!

On the other hand, if there was a brass outlet connected to metallic plumbing, or an earthed chain on the plug, I would expect a potential gradient from the drier to the earthed metal. It might not be the full 240V, but it could be sufficient to kill anyone between the drier and the ground. While the unbalanced current might be sufficient to trip out the ELCB, I for one would not place any real trust in this happening soon enough...

I firmly believe that a bathroom is no place for portable electric appliances. When our own home was being built, I had to argue very strongly — but finally won, so that there are NO power outlets in the bathrooms...

...the only portable electric appliances that should ever be taken into a bathroom are those operating from built-in batteries.

After thinking about the problem further, I still can't see how there can be a STRONG electric current in the fully insulated bath. The bath and contents can be considered as one plate of a capacitor, with the earth as the other plate. To pass 10mA at 240V it would need to have an impedance of 12k ohms, or about 0.25uF at 50Hz. That seems to be unlikely...

I have also discussed the problem with a friend who specialises in electrical safety, and have included copies of a few pages from an ISO publication which I think you will find useful. The graph on page 27 is particularly interesting, but it must be read in conjunction with the rest of the document to avoid mis-understanding. The curves are not absolute, and will vary for different people, age groups etc. Note particularly that the danger depends on both the current and the time that it flows. A 10mA current for 5 seconds from chest to left hand is just as deadly as 400mA for 20ms along the same path.

The nett result of the discussions was that a correctly operating ELCB might prevent a fatality if the bath is earthed in some way. But if the ELCB is faulty, or set for too high a current, or if there is no ELCB installed, then deliberately earthing the bath will be positively fatal.

I still firmly believe that there is no such thing as a SAFE 240V power point in a bathroom, and that they should be banned by law.

Thanks for your comments, Alan, and as usual they were very relevant. By the

way, the ISO information he enclosed with his letter is a report titled 'Effects of Current Passing Through the Human Body', apparently published by the IEC in 1984. The graph on page 27 is an attempt to relate current levels and time duration for alternating currents from 15-100Hz, flowing through a human body 'from left hand to feet', against various levels of physiological effect - i.e., degrees of shock. There is also a table giving the relative 'heart current' factor for various paths through the body.

As you can see, Alan Fowler's main points are basically the same as those made by the others, apart from reflecting his greater technical knowledge. It's interesting that he seems to have rather less faith in ELCB's than most other correspondents, and seems convinced that the only way to ensure safety in the bathroom is simply to keep portable appliances outside.

Relevant experience

But perhaps the most interesting and informative of all the letters to arrive came from Mr Graeme Daw, of Macedon in Victoria. It turns out that Mr Daw has considerable experience in biomedical engineering, power engineering and medical equipment manufacture. He also formerly owned a company producing ELCB's, so he is in an excellent position to comment authoritatively on the subject.

Actually his letter is quite long — some five pages of closely spaced typescript — so we haven't got anywhere near enough space to reproduce it in full. But he raises many very interesting points, so I'll try to include as many as I can:

The bath situation is a nasty one. To understand it a little better, we first take an unearthed bath and immerse two live conductors completely surrounded by a plastic container. Initially no bulk field will be radiated into the bath.

If holes are drilled progressively into the container, then the intensity of the bulk field outside the container will increase. When the container is completely full of holes, the sphere radius of this bulk field is about the distance between the conductors.

The current at any point in this sphere is most intense between the conductors and drops off as you travel towards the outside of the sphere. This current density is measured by displacing a portion of the fluid by back to back electrodes of known area.

The upshot of all this is that in an unearthed bath with the electrical appliance well covered in plastic and the average distance between the conductors in the appliance at only 20 to 40mm, then the victim may not receive more than a nasty jolt should they decide to be so wet!

However if an unearthed open bar radiator was placed in the bath, then the bulk field would be significant, and the victim would surely die.

We now earth the bath, or instal that metal plug chain along with the ELCB... The worst position is for the victim to be between the appliance and the chain; as soon as the appliance hits the water, we could have up to 3-6 amps flowing, depending upon the additives such as bath salts, body salts, dirt etc. With this sort of residual current the ELCB is going to act pretty quickly, as the detecting toroid transformer will have a large output; depending upon the brand of the ELCB it will remove the power after between 15-40 milliseconds.

Here is where the trouble may or may not really start, for the victim's heart is between the appliance and the bath chain, and exposed to a very high through current.

Mr Daw then gives a rundown of the effect of various current levels on the heart. Trying to summarise, it appears that current levels of 20mA or more tend to cause the heart to contract fully and stop beating, but in this case it will generally restart when the current ceases. This is the kind of current used in 'defibrillators', used to get people's hearts going again.

On the other hand somewhat smaller currents — say from 100uA to a few milliamps — can cause partial contraction but also depolarisation, and in this case the heart may not restart beating normally when the current stops, but begin random quivering or 'fibrillation'. It also appears that the heart is especially likely to enter fibrillation if such a shock occurs when it has just finished a normal contraction beat, and is repolarising for the next. During this repolarisation period — which lasts for about 40ms of each typically 1000ms heartbeat cycle — the heart is about 10 times more sensitive to being triggered into fibrillation. Even microamps of current, flowing through the heart at this time, can apparently be sufficient to produce fibrillation and likely death.

As Mr Daw points out, the exact outcome of the brief pulse of AC current that may flow through the victim's heart before the ELCB breaks the circuit will therefore depend upon the timing in relationship to their heartbeat cycle, the amplitude and waveform of the current pulse, and so on. It appears that there may easily be a situation where a 'defibrillation' phase is followed by one producing fibrillation, before the ELCB breaks the circuit; in this case the heart is left fibrillating, and the victim is likely to die. On the other hand if things happen in the reverse order, the heart will be left defibrillated, and able to begin beating normally — so the victim will live.

Mr Daw goes on here to say this:

If the situation gets down to heart fibrillation, then there is a real possibility that the ELCB may not save the day. This is one reason why in hospital operating theatres, isolation transformers are used with on-line leakage monitors — alerting the operator of the existence of a hazardous situation, before any current can flow. ELCB's are not used in highly hazardous cardiac situations.

With regard to your bath chain, I would consider an unearthed bath backed up with an ELCB the best of a bad situation. Once the bath is earthed the possibility of high currents flowing through the heart is a reality, with a high possibility of a resultant electrocution, with or without an ELCB. The only safe remedy is under no circumstances should any electrical appliance — battery operated or otherwise — be used in such situations.

He also makes a couple of very interesting comments about my reference to suppression capacitors, the sensitivity of ELCB's and exactly what this means:

Your query on suppression capacitors is real, for the reactance you have from the active to earth (including wiring capacitance) will reduce the amount of user current available. By way of example, if we have a 15mA unit and 10mA of residual current due to capacitance, this turns the 15mA unit into a 5mA unit — which will make the ELCB sensitive to nuisance tripping from other small transient leakages and RFI. The current/voltage phase relationship has no effect on this situation; the detecting toroid only responds to out of balance current.

ELCB sensitivity is a point not well understood. If a unit is marked 15mA, then the popular understanding is that 15mA is all the current that flows. This is not the case at all; up to about 4000 AMPS is available to flow to earth, until it is interrupted by the ELCB. The 15mA figure only specifies the minimum amount of earth residual current necessary to produce ELCB tripping.

That last point is a sobering one, isn't it? I suspect many of us have tended to assume that the tripping current level marked on an ELCB is the *maximum* current that can flow to earth, before it trips. When you realise that in reality a much larger current can flow, for the 15-40 milliseconds before the ELCB breaks the circuit, it really puts things into per-

spective. Until the ELCB actually breaks the circuit, the current is limited only by the impedance of the path to earth.

If nothing else, I think this information from Graeme Daw tends to put the final 'nail in the coffin' of Jeff Thomas's proposal to use an earthed bath chain. Quite apart from the doubts that have been expressed about the degree to which the field from an immersed appliance extends outward through the water, in an 'insulated' bath, there's now the further consideration that you could easily be killed by the current that may well flow to earth before the ELCB trips, if you use a chain to provide a 'good earth' to ensure ELCB tripping.

Actually I should perhaps add here that some correspondents have suggested Jeff Thomas's 'fully insulated' bath cannot actually occur. Even with a fibreglass bath and PVC drainpipe, they have suggested, there will still be enough water in the drainpipe to provide a reasonable leakage path to earth. Along with Alan Fowler's capacitance, that may well provide enough to trip the ELCB, without the need for introducing a metal chain.

Now that Graeme Daw has clarified the position about the current that can flow before the ELCB trips, and its effects on the human body, I for one would rather not have *too low* an impedance to earth — only just enough to trip the ELCB, in fact...

So all in all, I think we should be particularly grateful to Graeme Daw; he has provided us with a lot of very valuable information on ELCB's and some of the finer details of electrical safety.

Incidentally, Mr Daw also made a couple of comments about safety aspects of swimming pools and boat electrics, which I think you'll find equally interesting and thought provoking:

Just as a matter of interest, there are other equally dangerous electrical situations where people in salt water touch battery wiring on the sides of plastic or wooden boats. Here there can be sufficient current to cause death.

Inground pools with electric pumps earthed back to the MEN system can be equally as dangerous. It is unusual but not unknown for the MEN earth point to be raised to say 20 volts above absolute earth potential, due to heavy conductor currents. This puts the pump frame at 20 volts above absolute earth, and the very conductive water passing through the pump emerges at this potential.

Wherever the pump outlet joins the pool there can be a current of many amps passing directly into the drain hole. Should a swimmer pass through this field, his death would be assured and could well be put down to another pool drowning.

Gulp! Just as you thought that 'ultra low voltages' below 30V were safe, and that it was safe to swim in that backyard pool, Graeme Daw has to point out that it ain't necessarily so...

Thanks for those further sobering thoughts, Graeme, and I'm sure many readers will now be giving serious consideration to using an isolation transformer to run their pool pump, with a separate earthing system.

I guess it all shows that my comments about the human body being especially vulnerable, when immersed in water, weren't too far off the mark after all.

In fact I now don't feel at all guilty about opening this whole subject, by publishing Jeff Thomas's letter. Frankly I believe we've all learnt a lot about ELCB's and the exact nature of the protection they provide — don't you?

Incidentally just as this issue was about to go to the printers, another letter arrived — with some further information about ELCB operation, from a chap who designs them. We'll look at this and any more that turn up next month...

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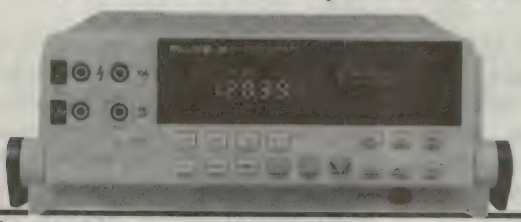

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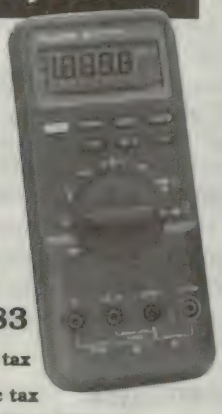

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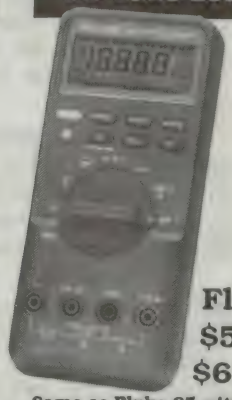

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READER INFO No. 17

Basics of Radio Transmission & Reception - 13

FM Receivers, demodulators & limiters

The one fundamental difference between radio receivers for FM and AM systems lies in the 'detector' or demodulator section. As well, FM receivers usually operate on VHF frequencies, have wider bandwidth IF stages, and include limiter stages to remove AM, noise and RFI.

by BRYAN MAHER

Receivers for reception of frequency modulated (FM) signals look similar to their AM (amplitude modulated) counterpart, as shown by the block diagrams for each in Figs.1(a) and (b).

Compared to AM receivers, some differences found in FM receivers are:

(1) The design of the detector or 'demodulator'. This is the one absolutely essential difference. (Incidentally these two names are interchangeable, though the latter is sometimes preferred in FM use.)

(2) In Australia FM receivers must tune the VHF FM band (88 – 108MHz).

(3) FM broadcast receivers have much wider IF (intermediate frequency) bandwidth, to respond to all significant transmitted sidebands (which extend over at least 250kHz).

(4) The IF section of an FM receiver usually has one or two extra stages, called 'limiters'.

In an FM radio receiver the FM demodulator (or detector) must respond to the frequency modulation of the carrier as received from the transmitting station, yielding the wanted speech, music, etc. Ideally the FM demodulation process should completely ignore any amplitude modulation present so that radio frequency interference (RFI) will not be heard.

AM/FM receivers

Perhaps you may want to ask, gentle reader, if a special FM demodulator is needed in a combination AM/FM receiver? The answer is 'yes'. FM/AM sets, either portables or cabinet, are almost two radios in one case. Usually only the audio and power supply sections are common.

Of the separate FM and AM sections, each has its own tuning, RF, mixer, local oscillator, IF, AGC and demodulator stages. For your convenience, the electrically separate tuning sections are both activated by the one tuning knob and dial.

The FM/AM selector switch selects the audio output of either the FM or AM demodulator. The chosen audio signal is then amplified by the common audio amplifier and fed to the speaker.

FM demodulators

Of the eight types of FM demodulator in common use, some are very simple, while others go to more complication seeking better results. Here we're going to consider just one demodulator type, the easiest to implement. It is a circuit whose operation is readily comprehended. But, as with most painless effort, we will see the results are not optimum.

The one we're going to look at is the *slope detector*, which was probably born by accident – more by inspiration than by perspiration. Anyone could have stumbled upon its principle.

Fig.2(a) shows a final IF amplifier feeding a tuned tank circuit L2/C2, while Fig.2(b) shows its response curve, similar to those we have seen before (Chapter 2, *EA* July 88, p124). Our frequency modulated IF signal is magnetically coupled in via L1.

However this FM slope detector uses (misuses?) the tuned circuit and its response curve in a rather sneaky manner. Instead of tuning the tuned circuit to the centre frequency, fc, of the received transmission (as might be expected), the slope detector is deliberately mistuned, to a different frequency, fo. (Strange carryings-on, you say!)

As Fig.2(b) shows, the L2/C2 circuit is tuned so that the centre frequency, fc, of the IF signal is about halfway up the side slope of the response curve. Frequency modulation swings the received signal frequency up and down by some amount, which we will call Δf. From fc the signal frequency changes up to $(fc + \Delta f)$, then down to fc, then down further to $(fc - \Delta f)$.

Observe the effect these frequency swings have on the response of the tuned circuit. Two things we immediately notice:

(a) Upward frequency swings produce much more response than do downward frequency changes. (Remember it's a dB scale – i.e., logarithmic).

(b) The output response varies with the modulation.

The detector circuit of Fig.2(a) will therefore produce a varying output, as the signal varies in frequency. So we have a very simple circuit which can detect frequency modulation and yield the required audio (or other) signals.

Utter simplicity and cheapness is the only thing going for this method of FM demodulation. However it is easy to understand its operation.

Disadvantages

The disadvantages of the FM slope detector are as follows:

(a) Audio distortion caused by its serious non-linearity of response (because of the non-straight slope of the response curve).

(b) The circuit also responds to any *amplitude* modulation that may be present, such as RFI, picture-on-sound effects in TV receivers, cir-

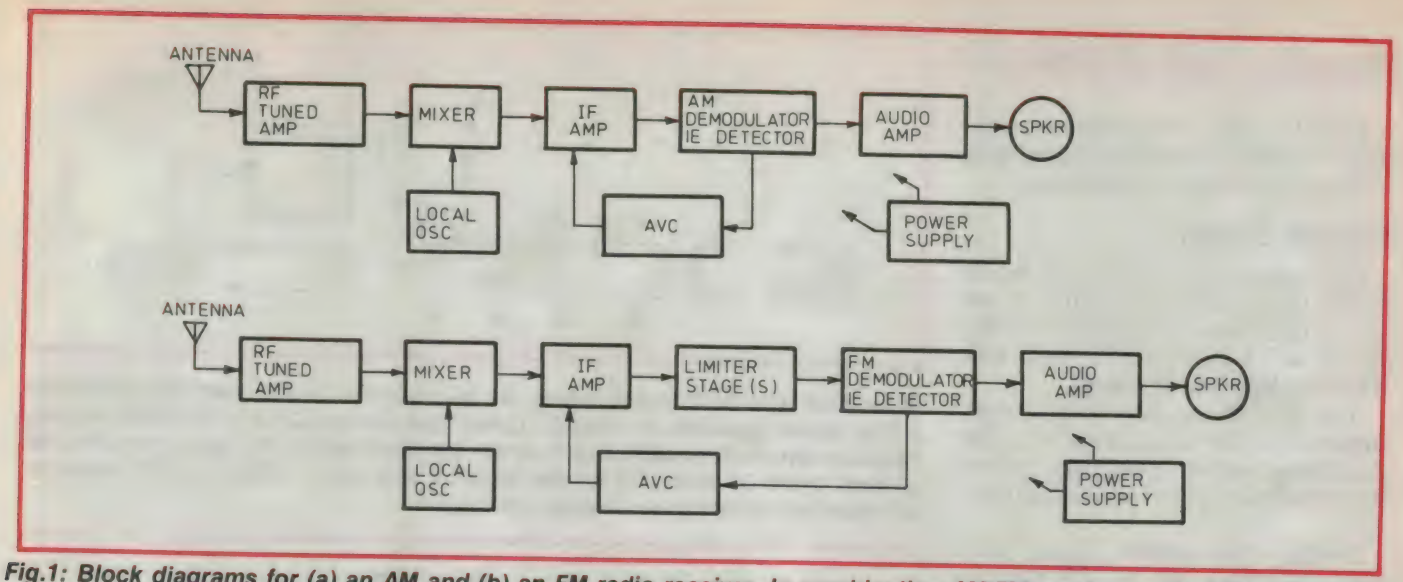


Fig.1: Block diagrams for (a) an AM and (b) an FM radio receiver. In combination AM/FM receivers, all of the above circuits are included up to the demodulators. The audio amplifier, speaker and power supply are usually common. In FM receivers, the RF, mixer and IF sections are similar to those previously described in AM receivers of similar frequency. Differences are that in FM receivers a completely different demodulator (or detector) is employed. Also the IF bandwidth is generally wider and limiter stages are used.

cuit noise, or interfering AM radio stations.

In fact this last point explains why you can receive FM signals on a VHF AM receiver, by de-tuning slightly off the station. But the results of this misuse are positively awful, and the technique is best kept for emergencies.

Limited use

Slope detection of FM signals has only limited application, because of its disadvantages. However you will find it used in some types of measuring instruments, where the value of some quantity is represented by proportional frequency changes in an RF carrier. Here the strong signals used obviate any RFI problems.

Also you may find the slope detector used in some of the most basic FM communications sets, or very cheap 'walkie talkie' handheld transceivers.

Overcoming RFI

With all types of FM demodulator the RFI problem can be considerably improved by preceding the FM detector with a special IF amplifier stage, designed to eliminate any amplitude modulation and/or noise present. Such an IF circuit is called a 'limiter' stage, and is usually placed last in the IF amplifier chain.

Many and varied are the circuits used for limiting, but all use the same basic idea: the output signal maximum amplitude should be constant, irrespective of any variations in maximum amplitude of the input signal.

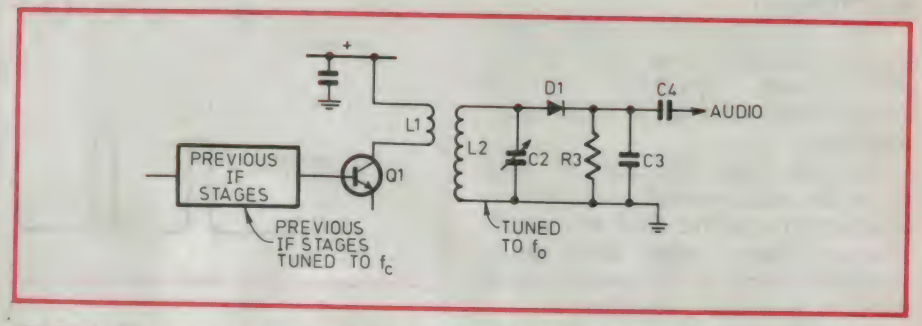


Fig.2(a): The essence of an FM slope detector. Q1 is the final IF amplifier. Previous stages are tuned to the FM centre frequency fc. L2/C2 is a tuned circuit tuned to another frequency fo, converting the FM modulation to (non-linear) AM. Diode D1 and its load R3 detect this AM, yielding the audio (or other) modulating signals. C3 bypasses any residual IF signal.

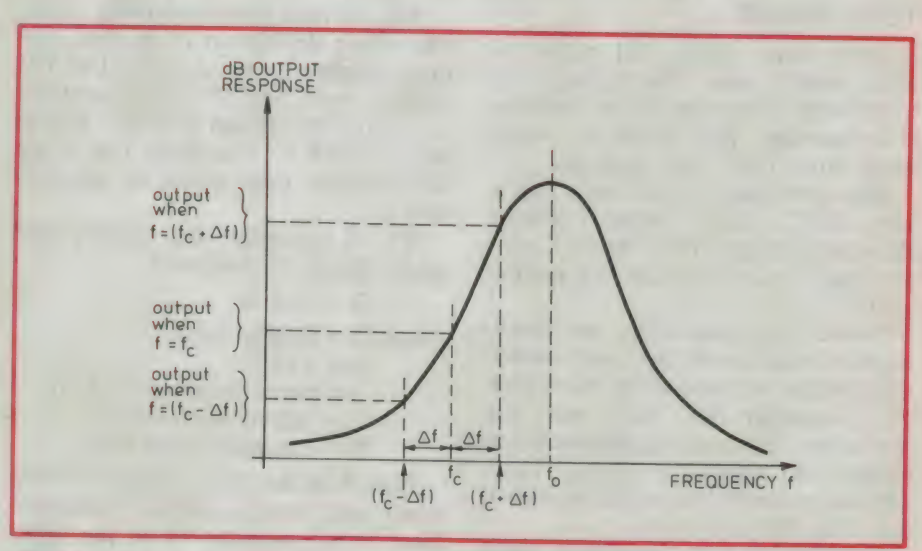


Fig.2(b): The response curve of tuned circuit L2/C2. Note that L2/C2 is tuned to a frequency fo, quite different from the centre frequency fc of the FM signal. This forces the complete FM signal and its frequency spread (fc +/– Δf) to lie on the side slope of the response curve.

Basics of Radio

In FM systems all maximum amplitude variations can only be circuit noise or that dreaded ogre – interference!

Limiter circuit

Fig.3 shows one possible IF limiter circuit. Q1 is a FET IF amplifier operating on rather low rail voltage. It is fed via T1 with a high level IF signal from preceding high gain IF stages.

The signal at the gate of Q1 is sufficiently large that Q1 is driven to saturation during positive input peaks, causing the drain-source circuit to conduct heavily.

During these positive input peaks bias current flows into the FET gate terminal. Also on positive drive peaks diode D1 becomes conducting, passing current from coupling capacitor C1 to ground. While flowing, these currents are charging C1.

After each cycle, as the input signal waveform decreases from the maximum positive value, capacitor C1 is left charged (negative at the FET gate side), as shown.

At times other than positive input peaks, this negative bias at the gate is sufficient to send the FET to cut off. Thus no source current flows during most of the cycle. In other words, Q1 is operating as a class C amplifier!

That's the vital point. Class C operation means very large drain current pulses, flowing for a very short part of each cycle – only during positive drive peaks, as seen in Fig.3(b).

Tank circuit

Those short, large, fast pulses of drain current also flow through L1, transferring energy into L2 by the magnetic coupling. This excites the tuned 'tank' circuit L2/C2, into oscillation.

Thus circulating currents are set up in tank L2/C2, and continue flowing throughout many cycles, excited again and again on every succeeding positive peak.

Now we all know from our knowledge of tuned circuits that tank circulating currents are necessarily sine waves. (We remember that, don't we?) But sine waves have constant maximum amplitudes and constant frequency! That's why the action of this oscillating tank is called 'the flywheel effect'.

Therefore all noise, amplitude modulation and RFI are removed from the signal. Eureka! We have a clean FM signal at the limiter stage output from L3.

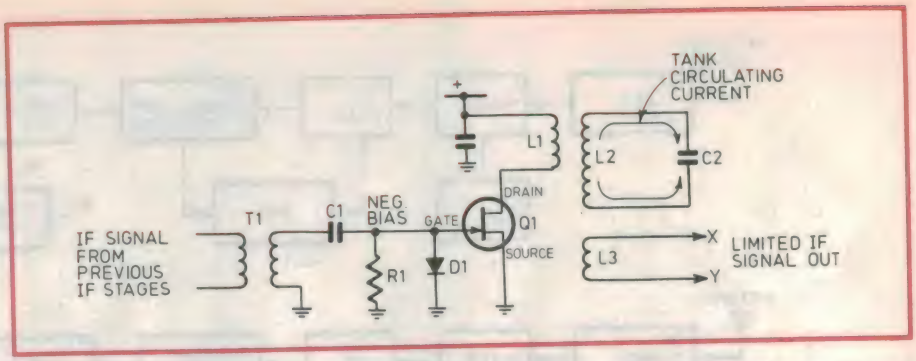
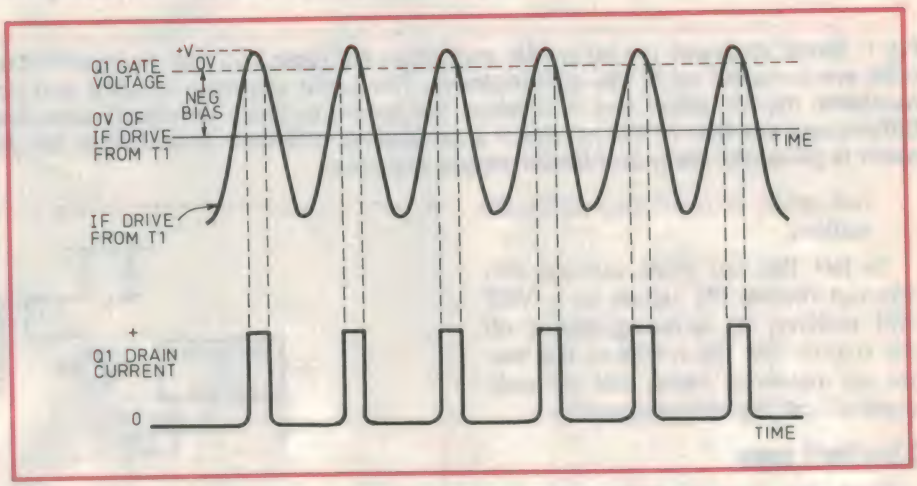


Fig.3: One type of IF limiter stage. Q1 is either the final or penultimate IF amplifier, which operates in class C. Tuned tank circuit L2/C2 is shocked into oscillations on each positive input signal maximum at the FET gate. For the rest of each cycle Q1 is cut off by the negative bias on C1. Thus any AM, noise or RFI (ideally) cannot pass through this stage.



Objection!

Now some readers may be spluttering in their coffee cups by now. Surely that last claim can't be true?

Yes, we must confess to being guilty. The above description is an ideal, not quite reached in the real world of FM systems, radio and TV receivers, static, and so on. The reason is simple. All the above would be beautifully true if we had a tuned tank circuit of infinitely high Q!

We all remember the tuned circuit quality factor, Q, don't we?

$$Q = 2\pi fL/R$$

where Q = Quality factor
π = 3.1416
f = tuned frequency in Hertz
L = inductance in Henries
R = a measure of all losses

That R in the above equation means much more than just the coil resistance. Here R is a measure of all the losses sustained by the tuned circuit. These include, in approximate order of importance:

(1) The coil ohmic resistance.

(2) The FET's drain output resistance, divided by the L2:L1 impedance ratio. (Impedance ratio is the square of the turns ratio)

(3) The loading resistance across L3, divided by the L2:L3 impedance ratio.

(4) Dielectric losses in the capacitor C2 and in all stray capacitances.

(5) Radiation resistance (of any stray signal radiation).

Now the sad fact is that at high frequencies, the coil's ohmic resistance (as you measure with an ohmeter) can be far exceeded by the other losses listed above. Though the losses listed in (2) to (5) above are not physical resistance (cannot be measured with an ohmeter), nevertheless they all impose power loading on the tuned circuit.

However those loadings can be mathematically represented as equivalent to some number of series ohms of real resistance. (A procedure we will leave to some other day – do I hear any sighs of relief?).

The net result of all this is that practical tuned LC tank circuits cannot be

made having working Q values exceeding 10 or 20 or thereabouts, using best design, low loadings and low loss components. But that's not very high!

Because of these small Q values the limiting action of circuits like Fig.3 (and all their ilk) are not at all perfect. Some RFI and amplitude modulation may break through, though not much.

If you live in the deep fringe areas plagued by excess static and tiny signals, (as your humble author and family once did) the results using one limiter can be very poor.

For these reasons two limiter stages in tandem are commonly seen, just about removing all unwanted noises from the signal. If the first can't catch 'em, the second one generally will!

But I still hear a troubled reader asking the $6.4 question. (It used to be the $64 question, but times are tough!) This is: if tank circuit circulating currents are absolutely pure sine waves (perfectly pure, good, ideal and so on), that means they have exactly one frequency. So how can there be any frequency modulation emerging from our limiter?

The answer again is the finite Q value of our tuned tank L2/C2 – in practice limited to around 20 or less.

Recall from past episodes that the definition of Q can also be equivalently written as:

$$Q = f/\Delta f$$

where f = tuned frequency; and
Δf = bandwidth

and both f and Δf are understood to be in same units.

Wildly enthusiastic readers will see immediately that the two equations above for Q must mean the same thing.

Now in most FM receivers the IF centre frequency is commonly 10.7MHz. If the tank of the limiter stage has Q = 20, then:

$$20 = Q = f/\Delta f$$
$$= 10.7\text{MHz}/\Delta f$$
$$\text{or } \Delta f = 10.7\text{MHz}/20$$
$$\text{So bandwidth} = \Delta f$$
$$= 0.535\text{MHz}$$
$$= 535\text{kHz}$$

Hopefully you recall from part 12 of this series (*EA* January 1990, p159) that the significant transmitted bandwidth of a typical broadcast FM station is about 262kHz. Therefore all frequency swings due to frequency modulation are happily accepted by our limiter tank circuit. We are saved by its limited Q.

At this stage we can pause, take a deep breath and have a cup of coffee or whatever, because that's enough to swallow for one day.

We have seen that the slope detector is the simplest FM demodulator, but is not very good. Limiters can fix any demodulator's RFI, AM and noise problem, but cannot help linearity errors.

So in the next time, we will look into the works of a very much better type of FM demodulator. Sleep well!

Postscript

If you're mad about equations, you can have some fun turning them inside out and upside down, as follows. The two equations for Q being equivalent, some cross multiplication leads to lots of fun:

$Q = (f/\Delta f)$, and also $Q = (2\pi fL/R)$

i.e., $(f/\Delta f) = (2\pi fL/R)$

cancelling f:

$$(1/\Delta f) = (2\pi L/R)$$

or if you like:

$$(\Delta f) = (R/2\pi L)$$

or equivalently:

$$R = (2\pi \Delta f L)$$

But remember to use fundamental units for all quantities, and also that R means the resistive equivalent of all losses, expressed in series ohms. Bye!

SPECTRUM

Communications News & Comment

AUST TEAM FOR VIDEO CODEC RESEARCH

A project group comprising Monash University, the University College of the University of NSW at the Australian Defence Force Academy, Canberra, Telecom Australia Research Laboratories and Siemens, has been formed to research and develop an integrated video and image communication system suitable for future broadband optical fibre based networks. The project has been offered a Generic Technology Grant of $1.8 million by the Industry Research and Development Board of the Department of Industry, Technology and Commerce, (DITAC). This will be matched by a comparable level of resources from the collaboratory organisations.

A team of fifteen of the leading Australian researchers in the field of video communications has been assembled, which will have access to facilities unsurpassed in Australia. Such a strong team in this field has never before been established in this country and its like exists with few other organisations in the world.

The group's task is to define a system in which a single video terminal will be able to be used for a variety of video services, including still image database retrieval, video telephony, video conferencing, added value television and high definition television.

Siemens recently completed this satellite earth station in Aerzen, Lower Saxony, for West Germany's Bundespost Telekom PTT. Used for both intercontinental and intra-European voice and data communication, it is West Germany's fifth such facility.

SECOND INTELSAT VI SUCCESSFULLY DEPLOYED

The International Telecommunications Satellite Organisation has announced that the solar array and antenna deployments of the INTELSAT VI (F-4) satellite has been completed and that in-orbit testing began on July 2. The tests of the satellite's communications payload and spacecraft systems were expected to last at least two months.

INTELSAT VI (F-4) was built by Hughes Aircraft Company and launched by a Martin Marietta Titan III rocket from Cape Canaveral, Florida on June 23 1990. Like other satellites in the INTELSAT VI series, the F-4 is nearly 12 metres high when fully deployed and, at an in-orbit weight of over 2500 kilograms, it is one of the largest commercial communications satellites in existence.

With the use of advanced digital circuit multiplication equipment, the F-4 could carry as many as 120,000 telephone calls and three colour television channels. It also provides Satellite-Switched Time Division Multiple Access, a significant technology that enables flexible interconnection of beams according to traffic requirements.

Following the completion of testing, the satellite will be moved to its final orbital location at 332.5°E longitude. It will replace the INTELSAT V-A (F-11) which will be repositioned over the Indian Ocean at 63°E longitude.

RECEIVER FOR AUSSAT'S OMNICAST

AUSSAT has recently announced the introduction of a new service known as Omnicast which makes use of FM^2 (FM squared) subcarrier technology, as a cost effective method for broadcasting audio and data services over the Ku-band satellite. A mixture of such traffic can be transmitted from a satellite uplink location, provided by AUSSAT, to a large number of small, inexpensive downlinks wherever corporations wish. The downlinks use Wegener's series 1800 FM^2 subcarrier receivers.

This receiver comprises a small satellite antenna, between 1.5 and 2.4 metres in diameter (depending on the location and availability of service required), a low-noise block converter (LNB) and the Wegener 1800 receiver.

High quality music, audio or data circuits can be configured within the one receiver, which can be addressable or non-addressable. The addressable format provides for remote control, from the customer's operational centre, of transponder selection, subcarrier frequency and authorisation.

Such systems have been in service in the USA for four years, with over 15,000 Wegener receivers currently in use by such organisations as Muzak,

AEI Music Network, 3M, Satellite Music Network, Braiker Radio, as well as UPI and Zephyr Weather for data distribution.

For further information circle 292 on reader service coupon or contact Magna-Techtronics, 7-9 George Place, Artarmon 2064: phone (02) 427 0666.

FDDI CATCHING ON IN THE USA

Not everybody may be ready for it yet, but FDDI is already being touted in the USA as *the* networking backbone technology of the 1990's.

"FDDI what?" you may well ask. The acronym stands for Fibre Distributed Data Interface and is one that is already receiving a lot of attention in the information exchange high technology industry.

FDDI is a high speed, fibre-optic ring local area network that offers data transmission speeds of up to 100Mbps. Many large US and European organisations are now installing such networks to cope with their present and future LAN requirements, as this speed is 10 times faster than today's Ethernet links.

Last year, Microsoft became the first company in the world to implement an FDDI LAN backbone network. Ungermann-Bass Inc installed the first phase of the high speed network at Microsoft's headquarters in Washington. The implementation provides interconnection for more than 20 UB Ethernet sub-networks, serving 6000 users at Microsoft's 11-building campus site.

For further information on FDDI circle 293 on reader service coupon or contact Ungermann-Bass, 604 North Road, Ormond 3204; phone (03) 578 0814.

DIGITAL SERVICES TO SINGAPORE

OTC Limited has announced the full commercialisation of digital cable services to Singapore, following the successful completion of end-to-end quality tests. Mr Bryan Sue San, OTC's Corporate Business Manager, said that the new service to Singapore was in line with OTC's initiatives in converting the international telecommunications transmission mode from analog to digital.

OTC already provides digitised analog cable network services to the United States and New Zealand via the ANSCAN cable, based on an OTC-pioneered concept of using specialised equipment to provide digital services over analog cable systems. The company has also signed an agreement to provide digital cable services to Indonesia.

DSS TRIALING ISDN WORKSTATION

The Department of Social Security is to trial a new Australian developed ISDN-based telecommunications system that has the potential to become a major export earner, according to Senators John Button and Graham Richardson.

With the help of a $548,129 grant from DITAC's National Procurement Development Program (NPDP), Australian ISDN product specialist firm Jtec will work with Telecom to integrate DSS' facsimile, computer and voice communications systems. The system will use a new integrated communications workstation developed by Jtec, which combines a phone, fax machine, photocopier, PC, laser printer, telex, voice messaging system, scanner and filing system.

The trial will be conducted in the 11 regional DSS offices of the south-west area of NSW. It will link those offices to the State headquarters and also to DSS central office in Canberra.

MIKE FOR AUDIO CONFERENCING

Some of Australia's top companies are leading a revolution in conference techniques through the use of an innovative audio-conference device.

Voicepoint, developed by NEC Australia, is said to overcome most of the problems previously associated with audio-conferencing.

The device is a low profile, one piece unit which sits in the centre of a conference table. It includes four built-in microphones, and advanced echo suppression and anti-feedback technology.

In practice, what this means is that a completely natural conversation can be conducted between two rooms equipped with Voicepoint, without voices being cut off at the end of sentences and without irritating background noises.

Conversation can pass freely in both directions at once, while any number of people are talking – just as if everyone is in the same room.

For further information circle 291 on reader service coupon or contact NEC Australia, 11 Queens Road, Melbourne 3004; phone (03) 267 6355.

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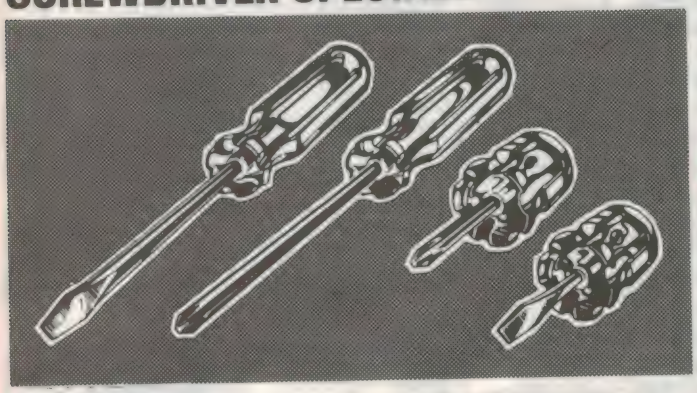

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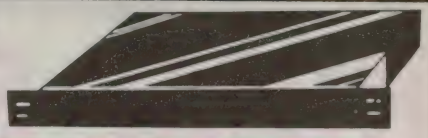


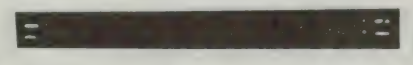
Just what your equipment needs for space efficient storage and a clean, professional finish. All are finished in black anodised brushed aluminium and conform to standard sizes so they're sure to bolt straight into your rack system with NO DRILLING!

Cases:

(All cases are 430mm wide & 254mm deep)

Cat No.	Height	Price
H-2483	44mm	$54.95
H-2485	88mm	$75.95
H-2487	132mm	$84.95

Save over $14.00 on every case!



Blank Panels:

Cat No.	Height	Price
H-2482	44mm	$9.95
H-2484	88mm	$19.95
H-2486	132mm	$23.95

Save $6.00 on every panel!

HARDWARE SAVINGS!

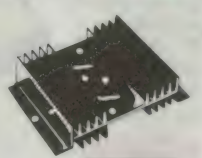
Power Heatsink

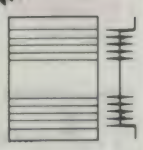
- It's interlockable - join as many as you need!
- Holds 2 x TO-3 packages
- Size: 78x110x33mm

Cat H-3461 **OVER 20% OFF!**

$5.95

Economy Power Heatsink





- Flag mounting design with fins top and bottom
- Holds 2 x TO-3, TO-26, or TO-220 ICs
- Cat Size: 74x102x25mm

Cat H-3471 $4.95 **OVER 20% OFF!**

Wisher TB-102 Tool Box

A sturdy plastic tool box with two full width trays, metal latches, and large carrying capacity.

Cat H-2570

NEW!

$49.95

Plastic Instrument Case

- Attractive black ABS case
- With carry handle
- Ideal for portable devices such as test gear
- Size: 200x95x140mm

Cat H-2506 **SAVE $4!**

$14.95

Weather-proof Switch Cover

Weatherproof your toggle switches with these screw-on rubber covers. Ideal for marine use or any outdoor situation.

Cat H-1914 75¢

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS:

N.S.W.: ARMIDALE: New England Electronics 711655 BALLINA: Ballina Electronics 867022 BOWRAL: F.R.H. Electrical 611861 BROKEN HILL: Hobbies & Electronics 884098 COOTAMUNDRA: Cootamundra Music & Lite 422561 COFFS HARBOUR: Coffs Harbour Electronics 525684 DENILIQUIN: Deni Electronics 813672 DUBBO: Chris's Hi Fi 828711 FORSTER: Forster Village Electronics 545006 GLEN INNES: John Sommerlad Electronics 323661 GRAFTON: Repairs and Spares 421911 GRIFFITH: Miatronics 624534 INVERELL: Inverell Electronics 221821 LEETON: Leeton Audiotronic 532800 LIGHTNING RIDGE: Cycle & Sound 290579 LITHGOW: Douroy Photographics 513173 LISMORE: Decro Electronic Services 214137 MOREE: Moree Electronics 522091 MUDGEE: Headware 723895 NARRABRI: Namoi Computer Service 923274 NELSON BAY: Nelson Bay Elect & Hobbies 813685 NOWRA: Nowra Electronics 210722 ORANGE: Central West Electronics 626491 PARKES: Strad Music Centre 623366 PORT MACQUARIE: Hastings Computer Service 834574 TAREE: Brads Electronics 526603 WAGGA WAGGA: Phillips Electronics 216558 YASS: Warmington Electrical 261116 YOUNG: Keith Donges Electronics 821279. **VIC:** BAIRNSDALE: LH & LM Crawford 525677 COLAC: Colac Electronics 312847 MILDURA: Pullman Auto Pro 232882 MORWELL: Morwell Electronics 346133 SHEPPARTON: Andrew Guyatt Electronics 219497 SWAN HILL: Nyah District TV Service 329303 WARRAGUL: Roylaine 234255 WARRNAMBOOL: Koroit St Elec Services 627417 **QLD:** AYR: Delta Electrix 831566 BUNDABERG: Bob Elkin Electronics 721785 CALOUNDRA: Electro-mart 918533 DYSART: Dysart Videotronixs 582107 INGHAM: Masons Electronics 763188 MACKAY: Stevens Electronics 511723 MARYBOROUGH: Keller Electronics 214559 NAMBOUR: Nambour Electronics Shop 411604 PIALBA: Keller Electronics 283749 **TAS:** BURNIE: Electronic City 314760 DEVONPORT: A.I.Electronics 248322 **SA:** MT GAMBIER: Hutchesson's Communication Centre 250400 PORT LINCOLN: Basshams TV & Comp World 822788 WHYALLA: Eyre Electronics 454764 **WA:** ALBANY: Micro Electronics 412077 BUNBURY: Micro Electronics 216222 GERALDTON: Batavia Lighting & Electrical 211966 KARRATHA: Daves Oscitronic 854836 MANDRAH: Micro Electronics 5812206 PORT HEDLAND: Ivan Tomek the Elect 732531

Snap On Heatsinks

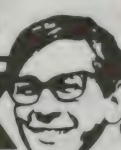
The fast, efficient and economical way to control heat dissipation.

Cat H-3416 Suits TO-220 case

Cat H-3417 Suits TO-126 case

Cat H-3416 $1.95

Cat H-3417 $1.95



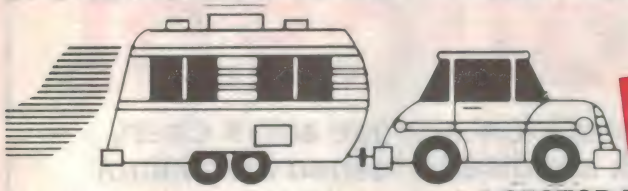
DICK SMITH ELECTRONICS

B1035/PB

FUN KITS FOR SERIOUS BUSINESS

HOME SECURITY KITS

GOING AWAY FOR CHRISTMAS?



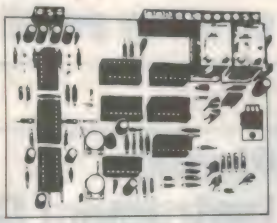
SECURITY IS A MUST!

2 SECTOR BURGLAR ALARM CONTROL UNIT

This Control Unit features variable entry and exit delays, LED status indicators, alarm driver circuitry, timed and latched outputs, two separate sector inputs, and the provision to add extra sector boards as required.

Cat K-8401

$39.95



2 SECTOR MODULE

Expand your K-8401 Burglar Alarm Control Unit. Add as many of these Sector Modules as you need. They hold two sectors, each with LED status indicators and isolating switches.

Cat K-8400

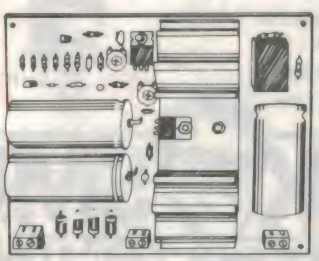
$12.95

BURGLAR ALARM POWER SUPPLY

Finally... a sophisticated BURGLAR Alarm Power Supply you can build yourself! It not only provides a 12 volt supply for your alarm, but recharges your back-up battery and automatically switches the supply between battery and mains should their be a power interruption.

Cat K-8402

$39.95

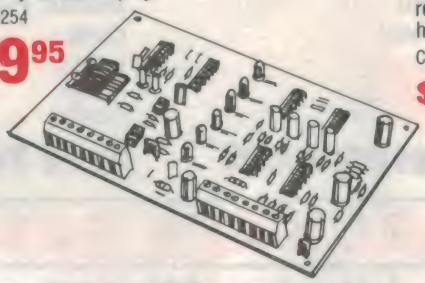


4 SECTOR HOME ALARM

With 4 sectors, this one board can control your complete home or office alarm system. It features separately adjustable entry and exit delays and LED entry status display.

Cat K-3254

$39.95



Sophisticated Security For Your Home Alarm!

ALARM PHONE DIALLER

An amazing device that can be fitted to almost any alarm system. If your alarm is triggered, the Phone Dialler calls the number you have programmed into it and emits a distinctive tone. The kit even includes a pushbutton telephone and Plug-pack power supply.

Cat K-8300

$79.95

UHF REMOTE CONTROL SWITCH

Use it for switching security systems, lights, or doors. This kit includes a frequency locked transmitter along with the switching unit which contains a receiver, decoder, and relay driver all on the one board.

Cat K-3258

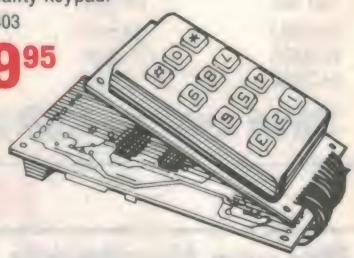
$79.95

COMBINATION LOCK

This keypad combination lock can be used to operate your K-8401 or other Burglar Alarm. Works with solenoid door locks too! It can even be wired to trigger the alarm when the lock detects repeatedly incorrect entries. The kit includes a high quality keypad.

Cat K-8403

$29.95



UHF TRANSMITTER KEY

This new design uses a SAW filter for improved frequency stability and eliminates the need for transmitter alignment. It features a flashing LED to indicate the button is being pressed and an automatic cut-out after 10 seconds if the button is accidently held down.

Cat K-3259

$29.95

Mains

Kits marked with this symbol involve mains power wiring. Take extreme care when working with this equipment.

Degree Of Simplicity

Simple | Intermediate | Detailed

DICK SMITH ELECTRONICS

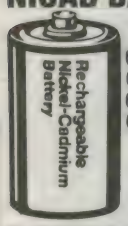
B1035/BL

POWER SOLUTIONS

PORTABLE POWER SOLUTIONS

Do you need to run battery operated devices from the mains? Do you need to run mains equipment from batteries? Do you even need to run 110V American gear in Australia? What ever your power needs you're sure to find a solution at Dick Smith Electronics!

RECHARGEABLE NICAD BATTERIES

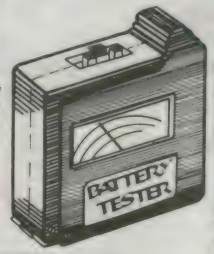


Cat S-3305	AAA	$3.95
Cat S-3300	AA	$3.95
Cat S-3301	C	$9.95
Cat S-3303	D	$9.95

BATTERY TESTER

Cat Y-5018

$5.95



12V GEL CELL RECHARGEABLE BATTERIES

Cat S-3315	1.2Ah	$29.95
Cat S-3316	1.9Ah	$32.95
Cat S-3320	2.7Ah	$37.95
Cat S-3322	6.5Ah	$49.95

AUSSIE REVERSE ADAPTOR

$8.95

Adapt overseas connectors to standard Australian power plug

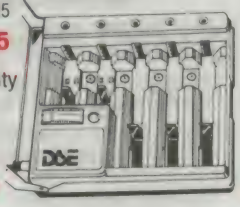
Cat M-7302

THE DSE CHARGING CABINET

- Charge up to 8 batteries at once!
- Even charge 3 9V batteries simultaneously
- Features charge lights for each cell and test meter

Cat M-9505

$39.95



High Capacity Nicad Charging Cabinet

Cat M-9506

$39.95

SLIMLINE CHARGING CABINET

- Charges up to 8 AA or AAA Nicad batteries
- Can also charge 2 9volt cells

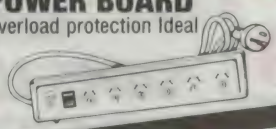
$22.95 Cat M-9508

6-WAY POWER BOARD

Comes with overload protection Ideal for Hi-Fi gear

Cat M-7170

$49.95

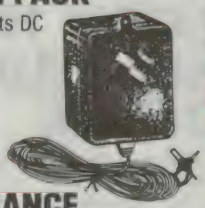


12V PLUG PACK

Supplies 12 volts DC at 1 amp

Cat M-9570

$24.95



HIGH PERFORMANCE POWER INVERTOR

- 12 volts DC to 240 volts AC at 600 watts
- Compact design housed in a robust alloy enclosure
- Attach it to your car battery to run TVs, VCRs, or even a small refrigerator

Cat M-5000

$525

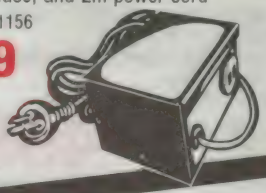
Run American equipment in Australia!

115VAC STEPDOWN TRANSFORMER

Includes an American style 2-pin plug, fuse, and 2m power cord

Cat M-1156

$99

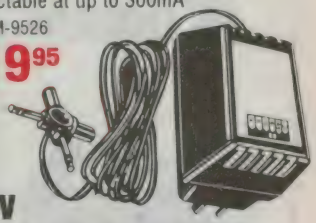


MULTI-VOLTAGE PLUG PACK

3, 4.5, 6, 7.5, 9, or 12 volts selectable at up to 300mA

Cat M-9526

$19.95



12V BATTERY CHARGER

- Delivers a powerful 500mA
- Ideal for charging Sealed Lead-acid or Gel-cells as used in burglary alarm
- Can be left running continuously

Cat M-9531

$34.95

Limited Stock!

AUDIO COUPLING TRANSFORMER

Ideal replacement part for radios or in any oscillator circuit

Cat M-0224

Only 25c

MICROWAVE OVEN LEAKAGE DETECTOR

- Checks your oven door seal
- Meter measures as low as 0.1mW psc
- Needs no batteries

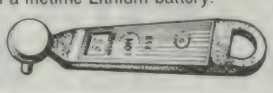
$24.95 Cat Y-4100

DIGITAL TYRE PRESSURE GAUGE

It's fast, efficient, and highly accurate with a lifetime Lithium battery.

Cat Y-5034

$29.95

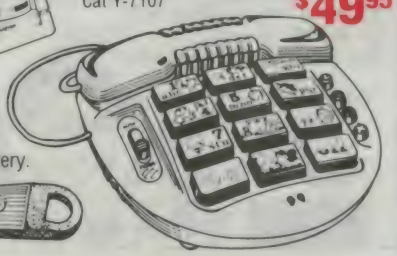


SMART PHONE

- Rings by itself and gives voice instructions
- Asks your child questions then responds in dozens of different ways — even corrects wrong answers
- Sound effects match each button
- For children aged 3 and up

Cat Y-7107

$49.95

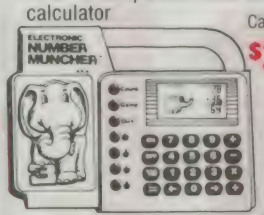


ELECTRONIC NUMBER MUNCHER

- 5 maths activities including a mixed quiz
- Plus it's the perfect kiddies first calculator

Cat Y-7129

$39.95



'JC' MY JUNIOR COMPUTER

- Just like a lap-top computer
- Includes 17 educational games
- Activity cartridges available

Cat Y-7266

Only $149

DICK SMITH ELECTRONICS

CB RADIOS & SCANNERS

UNIDEN BEARCAT 100XL HAND-HELD SCANNER

Listen to the exciting world of VHF and UHF transmissions with the Uniden 100XL Scanning Receiver.

- 9 bands covering 66-88MHz, 118-174MHz, 406-512MHz
- Keyboard frequency entry, 16 memory channels, Band scan and memory scan
- Includes in-built NiCad batteries, and AC charger
- 2 year Uniden Warranty

Cat D-2813

SCOOP PURCHASE! Limited Stocks! **$249**

UNIDEN BEARCAT 200XLT HAND-HELD SCANNER

One of the most sophisticated scanners available!

- 200 memory channels with scanning by auto search or keypad
- Includes a high capacity NiCad battery pack and charger
- 2 year Uniden Warranty

Cat D-2810 **$499**

* 200XLT Model Illustrated

HEAT SHRINK TUBING

Radiation cross linked, flame retardent, heat shrinkable, military grade polyolefin tubing. Now with that sort of description it has to be good! Sold in 1.2m lengths; shrinks in diameter by approx. 2:1 ratio.

SIZE	CAT NO	COLOUR	PRICE	10 UP
1.2m x 1.6mm	W-4100	Black	$2.50	$2.00
1.2m x 1.6mm	W-4102	Colours	$2.50	$2.00
1.2m x 3.2mm	W-4104	Black	$2.95	$2.45
1.2m x 3.2mm	W-4106	Colours	$2.95	$2.45
1.2m x 4.8mm	W-4108	Black	$3.50	$3.00
1.2m x 4.8mm	W-4110	Colours	$3.50	$3.00
1.2m x 6.4mm	W-4112	Black	$3.95	$3.50
1.2m x 6.4mm	W-4114	Colours	$3.95	$3.50
1.2m x 9.5mm	W-4116	Black	$4.50	$4.00
1.2m x 9.5mm	W-4118	Colours	$4.50	$4.00
1.2m x 12.7mm	W-4120	Black	$4.95	$4.50
1.2m x 12.7mm	W-4122	Colours	$4.95	$4.50
1.2m X 19.1mm	W-4124	Black	$6.95	$6.25
1.2m X 25.4mm	W-4128	Black	$8.95	$8.05

Certified to U.S. Mil spec #MIL-1-23053/5

With Electronic Tuning!

SLIMLINE AM CB

The elegant style of this Dick Smith Electronics CB will compliment your dashboard. At just 140x30x130mm, it fits exactly where you want it.

- Touch control electronic tuning
- LED signal strength/power output display
- Built-in noise limiter
- External speaker jack
- Complete with mic and mounting kit

Cat D-1200. DOTC Approved

Only $89

Extra Features...

Extra Value!

'SUPER LION' AM SSB CB

At this low price you weren't expecting all these quality features, but here they are!

- Inbuilt SWR meter
- Emergency channel 9 switch
- Squelch/Mic gain/RF gain/ Clarifier controls
- LED channel display
- PA facility

PEARCE-SIMPSON

Cat D-1711. DOTC Approved

Only $199

IDC GRADE CABLES

Cat W-2750 26 way $2.95/m
30m pack only $60 SAVE $15!
Cat W-2752 34 way $3.50/m
30m pack only $80 SAVE $8.50

DICK SMITH ELECTRONICS

B1035/PB

WIDE BAND RECEIVERS

BROADEN YOUR HORIZONS!

CHILDREN'S WALKIE-TALKIES

- At last... a stylish two-way radio for the kids to enjoy! Operates from 9 volt batteries (not supplied) D.O.T.C. approved

Cat D-1075

$19.95/pair

10 BAND SHORTWAVE RECEIVER

- Your local AM/FM stations plus 8 shortwave bands
- Includes a soft carry case
- Battery operated with sockets for an AC adaptor and headphones

Cat D-2834

$79.95

Bring The World Into Your Home!

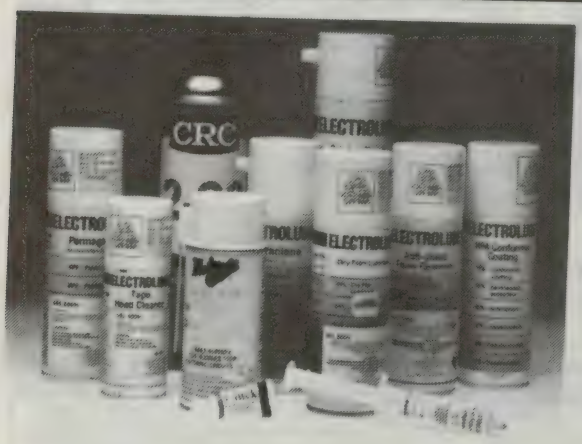
SANGEAN MULTIBAND RECEIVER

- AM/FM plus Long Wave, Medium Wave & Short Wave (150kHz to 30MHz)
- Digital frequency display, with keyboard or dial tuning
- 24 hour clock with sleep timer
- Plus a host of other features

Cat D-2831

$299

SERVICE AIDS *COME IN AND SEE OUR HUGE RANGE!*



TWO FOR ONE SALE!

PERMAGARD

- Penetrates, lubricates, and displaces moisture
- Protects metal tools & parts from corrosion

Cat N-1120

$9.95

BUY ONE GET ONE FREE!

ELECTRONIC CLEANING SOLVENT

- Ideal cleaner for any electronic equipment
- It's non corrosive and leaves no residue

Cat N-1100

$10.95

TAPE HEAD CLEANER

- An efficient magnetic tape head cleaner
- Will not harm plastics or rubber

Cat N-1155

$8.95

THERE'S SURE TO BE AN OZONE SAFE SERVICE AID TO HELP YOU TOO!

SPRAY FREEZER

- Use it to detect faulty components and solder joints
- The safe way to cool small components

Cat N-1110

$22.95

AIR DUSTER

- High pressure inert gas for cleaning circuit boards and delicate equipment

Cat N-1150

$24.95

DICK SMITH ELECTRONICS

NEW BOOKS AND LITERATURE

Cellular phones

THE CELLULAR RADIO HANDBOOK, by Neil J. Boucher. Published by Quantum Publishing, 1990. Hard covers, 287 x 222mm, 526 pages. ISBN 0-930633-17-2. Price $260.

A couple of months ago I reviewed another fairly solid handbook on cellular radio phones, written mainly for technicians wanting to set up as an installer and/or repairer. Here's another handbook on the same broad (and very topical) subject – only this time it's about twice the size and even *more* comprehensive. In fact it's a veritable cornucopia of reference information, covering just about everything one would need to know about designing, setting up and operating cellular radio systems.

Neil Boucher, the author of the present volume is an acknowledged world authority on the subject. An Australian, he has held top engineering and management positions with Telecom Australia, and has been instrumental in the creation and implementation of cellular systems throughout many Pacific Rim countries. He has presented dozens of technical papers and workshops on the subject, and is currently Chief Technical Advisor, Cellular Radio, for the International Telecommunication Union (ITU). It would be difficult to find an author better qualified in this subject!

Unlike other books I've seen on cellular, which have been devoted almost exclusively to the AMPS system and the US scene, this one devotes a significant amount of space to other systems throughout the world. In fact the emphasis throughout is on objective evaluation of all aspects of the technology – both in terms of historical development, current capabilities and future potential. This should make it a valuable reference to almost anyone, whatever their country; a truly 'international' work.

Quite apart from that, it's also both comprehensive and *thorough*, as a listing of the 35 chapter heads will show: 1 – What is Cellular Radio?; 2 – World System Standards; 3 – Basic Radio; 4 – Cell Site Selection and System Design; 5 – Radio Survey; 6 – Cellular Radio Interference; 7 – Cell Plans; 8 – Units and Concepts of Field Strength; 9 – Radio Base Stations; 10 – Base Station Control and Signalling; 11 – Cellular Repeaters; 12 – Antennas; 13 – Microwave Links; 14 – Base Station Maintenance; 15 – Basic Switching and Trunking; 16 – Traffic Engineering Concepts; 17 – More About Switching and Trunking; 18 – Numbering Schemes; 19 – Mobile Installation; 20 – Towers and Masts; 21 – Installations; 22 – Equipment Shelters; 23 – Budgets; 24 – Billing Systems; 25 – Marketing; 26 – Choice of Analog Modulation/Demodulation Methods; 27 – Noise and Noise Performance; 28 – Roaming; 29 – Data Over Cellular; 30 – Privacy; 31 – Rural Applications of Cellular Radio; 32 – Preparing Invitations to Tender; 33 – Digital Cellular; 34 – Other Mobile Products; and 35 – Glossary of Terms.

As you can see, it covers just about every possible aspect of the subject. And as far as I can see and judge, it's all good meaty stuff. If you want either an easy, superficial introduction on one hand, or an abstruse theoretical analysis of cellular switching theory on the other, it's not for you. Mr Boucher has set out to produce a solid reference manual for cellular radio in the real world, and that's exactly what you get.

Can a book that sells for $260 be described as cheap? I wouldn't have said so, but I suspect this one is just that. After all, it's a distillation of the knowledge and skill of a world authority on the subject, and as current as you can get.

The review copy came from DNA Communications, of PO Box 69, Broadway, Brisbane 4006, and the price quoted includes packing and postage throughout Australia, New Zealand and Asia. Further information is available from DNA by phone, on (075) 914 956. (J.R.)

Solder technology

SOLDER PASTE IN ELECTRONICS PACKAGING, by Dr Jennie S. Hwang. Published by Van Nostrand Reinhold, 1989. Hard covers, 236 x 160mm, 456 pages. ISBN 0-442-20754-9.

A complete textbook on just *one* aspect of soldering technology? It may seem bizarre, but the fact is that soldering by paste reflow has now become a major fabrication technique in the manufacture of both electronic components and equipment. The growth of automated manufacturing and surface-mount assembly technologies has seen to that, and solder paste technology has had to move quickly from 'black art' to well understood technology – complex though it may be (and undoubtedly is).

The subtitle of this book is 'Technology and Applications in Surface Mount, Hybrid Circuits and Component Assembly', and this gives an idea of both its broad scope and the applications of the technology. Dr Jennie Hwang is a very knowledgeable and experienced authority on the subject, with a PhD in Materials Science and Metallurgical Engineering and MS degrees in both liquid crystal chemistry and organic chemistry. She holds several US and overseas patents on paste technology, and is currently technology manager and product manager at SCL Metal Products in Cleveland, Ohio.

Essentially she has produced a reference book for manufacturing engineers, equipment, component and PCB designers, and anyone else involved in production soldering using paste technology. It should also be of considerable value as a reference work for both researchers and engineering managers.

It's very concise, with a great deal of both theoretical and practical data on the composition, behaviour and application of solder pastes. There's also a big chapter on quality assurance and testing. So all in all, it seems a major reference work on this increasingly important manufacturing technology.

The review copy came from the local office of the publisher, at 480 La Trobe Street, Melbourne. (J.R.)

The Serviceman

More frustration all round, from intermittents – real and apparent

Our opening tale this month comes from a contributor, and it's one of incredible frustration with an intermittent fault in a National VCR. There's another story about an 'intermittent' that really wasn't – and caused by something quite unexpected. Finally I have a story of my own, of a case where I was guilty of misjudging the customer.

This first story is not about a true 'intermittent', although it did appear to come and go like one. Even tracking down the circumstances that made the fault show up was an interesting – though frustrating – exercise in servicing.

The story comes from L.G., of Robina in Queensland, and I'll let him tell the story in his own words:

I was inspired to write after reading the story of the Hitachi VCR with a 'dirty heads' problem, in the June edition. My story is very similar but was, at least to me, much more frustrating.

It concerns a National VCR, model NV600 and the call for help was to the effect that it had 'dirty heads'. Now, quite often I regard most of what my customers say with some degree of scepticism. But in this case the client was well known to me and he uses most of his nine (yes, that's right – NINE!) VCRs every day for both business and pleasure, so I always feel that he speaks with some degree of knowledge.

I had previously advised him not to use cleaning tapes and so on the odd occasion when the heads may have required cleaning, (outside the annual service that I do for him) he calls me and I call in to see him at the earliest opportunity.

So next morning I called to check the machine. First, I lifted the cover and gave the works a good physical inspection. I was looking for obvious signs of damage, or foreign objects in the mechanism. (I once found about a desertspoonful of 'play dough' in a VCR – but that is another story.)

Everything appeared OK, so I inserted a tape and pressed the play button. Sure enough, it was just as my customer had reported – for all the world like a case of dirty heads.

At this point he told me that he had started to record for one of his clients, using a tape supplied by the client, when this problem first occurred. He had ejected the cassette and inspected the tape inside, only to discover that it had more wrinkles than an elephant on the pension.

As he still had the tape on hand, I looked at it and confirmed that it was in terrible shape, fit only for the rubbish bin.

I proceeded to clean the heads, but all to no avail. Reluctantly I came to the conclusion that the heads had been damaged and would require replacement. So I packed up the machine, took it to the workshop and ordered a new head assembly.

But wouldn't you know it? There wasn't a single head of the required type in all of Southern Queensland! The machine was put to one side and I waited for some days for the part to come from the South.

The head finally arrived and I proceeded to fit it – quite a simple operation as you are no doubt aware. Unfortunately, when I played my test tape, the picture was still exactly the same as it had been. For a time I couldn't believe it, and just sat there watching the faint shadow of a picture behind all the hash and snow.

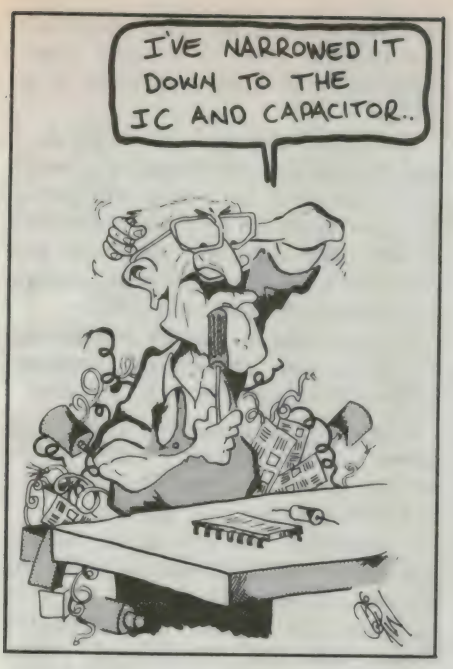
I have struck the odd case where this effect is caused by different faults such as dry joints and faulty IC's, so I pulled out the service manual for the particular model and set up the trusty CRO in preparation to make some checks. But when I looked at the picture again, it had changed considerably.

I was now looking at a picture which implied strongly that my monitor TV had a horizontal sync problem – bands of picture about 30mm wide sloping diagonally from right to left. I was pondering this when the picture started to come upright, and then to go diagonally from left to right. Then about 30 seconds later the picture had righted itself; and there was one of the best pictures you would ever wish to see!

I decided to run through the servo system, as I dimly remembered that I had once had a fault in a National VCR where it had a faulty CYL FREE RUN adjustment pot. This caused the cylinder speed to hunt up and down while trying to lock in. This can cause the picture apparently to lose horizontal sync, first one way then the other as the drum speed varies.

It goes without saying, I guess, that in this case everything was spot on.

So I pondered on what to do next? And 'next' turned out to be something quite different. I was trying to connect the CRO probe to a test point and had



to exert a small amount of pressure when the capstan speed increased dramatically. I released the pressure and things returned to normal...

Now I had struck this one before. The capstan motor driving transistors are mounted on a heatsink at the end of the servo board, and are soldered onto the board. It is relatively common for these transistors to develop dry joints, and this can cause the capstan motor to change speed. And so it was to be. A bit of gentle poking of the board and a close inspection of the transistors revealed the classic dry joints. A touch with the soldering iron and that was fixed.

Having done this, I wondered what would happen when I switched the VCR back on. But I needn't have worried, as the picture was still lousy. I was prepared for it this time and I used the CRO to look for pulses, waveforms etc.

As far as I could tell, everything was normal except that there were no head switching pulses. I turned to the circuit to refresh my memory and when I turned back to the unit, the picture was perfect.

Naturally enough, now all pulses were present and correct. So all that was left for me to do at this point was to check the capstan circuit – and no amount of pushing, probing, heating or cooling caused any variation to the capstan speed. So at least that was fixed!

I wondered if there could there be a dry joint in the drum circuit. It was possible, but no amount of inspection or probing would cause any change; so it seemed that was unlikely.

A heat sensitive component? No amount of freeze spray could induce a change, so that too was unlikely. I switched off and studied the circuit in more detail, looking for something that would explain the only clue – that at times there was no head switching pulse.

The pulse is processed in IC2001, a UPC1504C1 and is derived from the PG Pulse picked up from the drum. The pulse is applied to pin 22 of the IC via C2004, a 10uF/16V electrolytic capacitor. Whilst I had been pondering this I had stopped the VCR, but had left it powered up. When I later pressed the play button, the picture came up perfectly and of course all pulses were present.

It seems that on previous occasions, I had turned the power off between checks. But now I performed a number of checks and soon determined that if the VCR was left powered up, it would always work perfectly. However if it was actually turned off, then after a couple of minutes it would take a while for the picture to come good. I should mention that there was never any trouble with EE mode.

Armed with this knowledge, I powered up and checked for pulses and voltages. The PG pulse from the drum was there, 0.2V p-p, exactly as the circuit said it should be. All other pulses around the IC were there – but no switching pulses. It simply had to be the IC; but as might be expected, I didn't have one and neither did the agent. It was placed on order.

A few days later the IC arrived and I proceeded to change it over. Need I say that it didn't cure the fault?

Being slightly frustrated at this point, I went through my reasoning again. There is a pulse applied to an IC, all voltages on the IC are within 5% of what the circuit says, there are a number of outputs from the IC and they are all there with one exception – the head switching pulse. Could there be something loading the pulse? I isolated the output and tried again; but still nothing.

At this stage I had gone from slightly to extremely frustrated, and as everything around the new IC was exactly the same as the old one I elected to refit the old IC and put the new one in stock. How I wish I hadn't done that! Being almost at the straw clutching stage, I decided to remove C2004 and check it.

On the capacitance meter it came up almost spot on, a fairly rare occurrence. But over the years I have found that a capacitance check is not always conclusive, so I normally apply a square wave to capacitors. Sometimes it's amazing what this shows up, but in this case it revealed nothing.

Over the next week or so I spent a considerable number of hours checking waveforms, voltages, transistors and anything else that was remotely connected with head switching pulses. And all to no avail.

I decided to put a new electrolytic in circuit just in case, but it made no difference at all. I don't know why I decided on my next move, but I put the new IC back in – and lo and behold, the machine burst into life as though it had never had a problem at all!

Yet all I had done was to fit a new IC AND a new capacitor, neither of which by itself had had any effect.

This seemed so silly that I just had to confirm it! I had spent so much time on the job that another hour or so was neither here nor there. I tried all different combinations of the IC and capacitor with the end result being that both IC and capacitor had to be new for the VCR to work correctly.

I have pondered on this problem this many times in the past weeks. The only conclusion that I can come to is that somehow both items were interacting with each other when voltage was first applied and then gradually they would settle back to normal. Who knows? I certainly don't!

Even though this story may be a bit long winded I hope that it will point up the need to 'expect the unexpected'.

Thanks, L.G. I imagine that most of us have come across a fault something like yours in the past, but how many of us would have the patience or persistence to follow it through to the end.

Then again, L.G. was lucky to have a customer willing to let him persist with the problem. In my experience, most customers want their jobs finished yesterday and would be prepared to put up with this kind of momentary fault, particularly as it could be avoided by leaving the machine powered up.

Fault that wasn't

Now we move south, to Victoria, for a story about a fault that wasn't. Wasn't a fault, that is! It comes from D.M., of Murrumbeena.

It's not often that we get a story about computers and computer peripherals in this column. No doubt there are service problems with these machines, but by and large they work on for years without ever having their covers removed.

Nevertheless, problems do occur and finding the solution can be long and involved. D.M. got as far as the table-thumping stage before the answer re-

vealed itself. He tells the story thus:

My story concerns my sons' Commodore 1541 disk drive, which developed an apparently complicated intermittent fault a couple of years ago.

During one especially cold winter my eldest son informed me that the disk drive was failing to load some disks. Usually, if the 1541 consistently fails to load a program, it indicates a bad disk. More so if the disk in question has been handled by my two boys, whose attitude towards floppies mirrors that of my attitude to vinyl records when I was their age.

I have my own computer and 1541 disk drive and found that the disks in question were OK, which implied that the boys' drive was indeed the problem. Moreover, the problem with their drive appeared to be intermittent; disks would sometimes load OK but more often than not would 'bomb out' with a read error.

I knew from my reading of magazine articles on the 1541 that a lack of torque often prevented the drive from reading disks with dust jackets that are thicker than normal. The small amount of extra friction is apparently sufficient to prevent the drive from bringing the disk up to the correct speed. Perhaps the winter damp had penetrated the dust jacket and rendered previously acceptable disks unreadable.

To cut a long story short, I found that using disks that were loose in their jackets improved the chance of loading a program, but didn't really solve the problem. I then tried dismantling the drive and lubricating likely moving parts, but this didn't solve the problem either.

Now, although I've been a reader of EA since my early teens, my level of expertise in electronics is not very high; in most of my tinkering I make use of junk box components. So while I'm fairly happy with simple valve and transistor circuits, I find modern digital electronics more than a little daunting.

In the end, the drive was sent back to the shop from whence it came. Two weeks later I was able to pick it up for the small consideration of $50. After bringing it home I was pretty unimpressed to discover that its behaviour hadn't altered at all. I took it back to the shop and asked them to have a second look at it, only this time I thought I'd demonstrate the problem and took along a few disks.

You've probably already guessed that the drive performed faultlessly in the shop. I returned home thinking dark thoughts about 1541s – particularly the one I was carrying! These thoughts were intensified when I tested the drive immediately on my return home and discovered that it had reverted to its (now) normal error-prone behaviour.

With considerable reluctance I forced myself to set aside the theory that the drive hated me, and to consider more rationally why it had behaved so well in the shop. I had already tried swapping computer, cables and drives at home with no change in the fault, so it could hardly be a difference in the shop's computer. Then it struck me! The only difference between the setup in the shop and that at home was the mains power supply.

And that what it was! I quickly got out my multimeter and measured the mains voltage. The reading was around 170V! I waited until 3:00am before my next measurement and found that it had improved to about 195V. Subsequent enquiries with the SEC led to an investigation into the mains voltage being delivered to our home and it was discovered that repairs were required to the three-phase supply in our area.

The intermittent behaviour of the drive was due to the combination of a mains supply fault and the extreme variation in power use during winter.

But then why hadn't my own computer's drive reacted in a similar fashion to this variation in the mains voltage?

Although they are the same model drive, they had one important difference: my drive is Japanese-made and rated at 220V. My sons' drive was manufactured in Germany and was rated at 240V. The 1541 could hardly be called mains-voltage sensitive when it exhibits erratic behaviour while being underpowered by 70V.

As a quick solution, I opened the drive and changed the voltage tapping down to 220V. My drive has run at this setting for some years, so I figured it wouldn't do the other drive any harm. In any case, I've never found the mains voltage in my area to be much over 230V.

It's interesting to consider how having 'two of the same' can actually complicate rather than help matters in fault-finding.

It certainly is interesting, D.M., and serves as a reminder that '240V' AC is not always what it seems. Particularly so as I write this on a cold July day.

I remember that low mains voltage was once a major problem in radio and TV sets, in the days of 5Y3 and 6N3 rectifiers. (That dates me, doesn't it?) Those sets had unregulated power supplies, and were not at all happy when the mains voltage dropped by 10% or so.

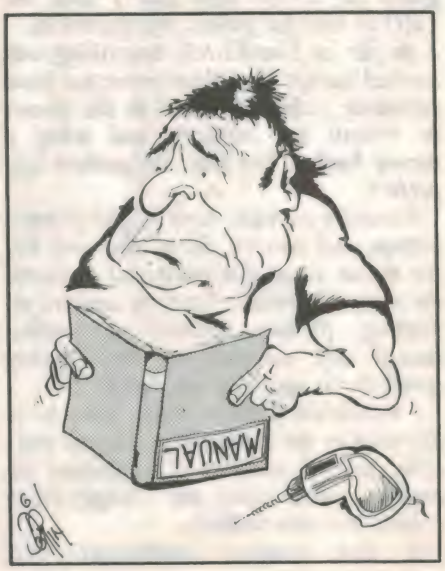
Modern series regulator and switchmode supplies have reduced those problems considerably but, as D.M. shows us, have not eliminated them entirely.

Hi-tech trap?

Now for a short item from my own workshop. This shows just how easily one can be trapped by modern technology, into overlooking the basics.

It concerns a late model Philips colour TV, a KR786 fitted with a KL9A3-FS chassis. This is a 63cm fully remote control stereo set, with all the modern bells and whistles. It is also, significantly, just out of warranty.

The customer complained that whenever he switched the set on, it came up with the sound blaring out loud, and the



picture varied from bad to terrible. Every day he had to readjust the sound and picture before he could enjoy the programmes.

He brought with him the owner's manual, which turned out to be a wise move because I had no knowledge of the particular model. A careful read of the booklet told me how to adjust the set and I soon had it displaying a first class picture, with excellent stereo sound.

According to the user manual, it was advisable to store the PP (for Personal Preference) settings in the set's memory, so that it would come back with normal performance when next switched on.

After this, the set worked perfectly every time I switched on. For several days I kept repeating the start-up process and the set never once missed a beat.

In the end, I came to the conclusion that the owner just hadn't appreciated the PP function, and the set was just resetting itself to some arbitary setting in its memory. I resolved to explain the function fully to the owner, so I called him and suggested that he come and pick up his TV.

However, a weekend intervened before he appeared and when I switched on on Monday morning, the set fired up with no picture and loud hash from the speaker. So there really was a problem, and it wasn't just the owner not reading the handbook!

Obviously, the set was losing its memory, and this was probably because of a fault in the back-up power supply. I had no idea what this supply might be, but assumed that it was either a small NiCad battery or one of those 'super-caps'. In the event, I found a small 2-cell NiCad pack on one of the circuit boards.

Now two NiCad cells should deliver 2.4V, but this one could only supply 0.3 volts. In other words, it was very flat. I removed it from the board and then switched the set on. The battery terminal voltage came up to 2.9V which would normally be enough to recharge the battery, if it were capable of accepting a charge.

I put the old battery across my bench power supply and after an hour or so it's terminal voltage had come back up to 2.3V. But it would not hold a charge, and two days later it was back down to 0.3V, even without a load.

So a new battery restored the sanity to an otherwise excellent television. It's just a pity that the battery didn't fail a month or so earlier, while the set was still under warranty.

More importantly, I've learned not to consider the customer a 'dill' just because he seems not to understand the user manual.

That's all for this month. Next time we'll be back with more tales from your bench and mine.

Fault of the Month

Pye T29 chassis

SYMPTOM: Almost no vertical scan. Picture reduced to a one-inch band across the center of the screen. Circuit diagram gives no useful voltages, but those measured appear to be reasonable.

CURE: Q504 (BC638) faulty. The transistor checks OK both in and out of circuit, but simply will not amplify signals applied to its base.

This information is supplied by courtesy of the Tasmanian Branch of The Electronic Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Test Instrument Review:

Smith Design's VOS-107 Spectrum Probe

Generally only those working in well-heeled design labs have been able to use a spectrum analyser, up until now, because most such instruments are both big and *very* expensive. But now there's an analyser small enough to slip into your pocket, and priced low enough to bring it within many enthusiasts' budgets.

by JIM ROWE

Spectrum analysers are very handy instruments, letting you examine signals in the frequency domain as conveniently as a conventional scope lets you look at them in the time domain. This lets you check equipment and circuits for spurious outputs or radiation, check transmitters for unwanted modulation, check the frequency response of preamps, filters and converters, verify antenna matching and so on.

Unfortunately full-blown spectrum analysers also tend to be far from cheap, with price tags often rivalling those of well-fitted out family cars. They also tend to have an array of controls almost as numerous as those in a 747 cockpit, and calling for a similar degree of driving expertise. All of which takes them out of the realm inhabited by most of us in electronics, of course.

But if you've long given up on the idea of ever having even a modest spectrum analyser of your very own, it's time to think again. Because every so often, someone comes up with a really innovative solution to a common measurement problem, and that event has just occurred as far as spectrum analysis is concerned. If you have a conventional scope with a bandwidth of at least 1MHz (and that should apply to most nowadays, except the vintage clunkers), there's now a low-cost way to use it as an easy to drive 100MHz spectrum analyser, whenever you wish.

The VOS 107 Spectrum Probe comes from a hitherto unknown little firm in Dresher, Pennsylvania, called Smith Design. It's built into a probe case just a little longer than a familiar logic probe, as you can see from the photo.

In fact it measures only 190mm long by 25mm in diameter, and weighs a mere 56g (2oz).

There are basically two cables coming out of the rear of the probe. One hooks up to a small plug-pack supply (included), for power, while the other has a BNC plug and simply connects to the Y input of your scope. That's it! No array of complicated controls, in fact no controls at all apart from those on the scope itself.

You simply set the scope's vertical sensitivity to 50mV/division, and the timebase controls for 500us/div (0.5ms/-div) and negative edge triggering. The display on the scope then effectively becomes that of a spectrum analyser, with the horizontal axis representing frequency from virtually zero to 100MHz (i.e. typically about 10MHz/div), and the vertical axis representing logarithmic signal level – scaled at approximately 10dB per division.

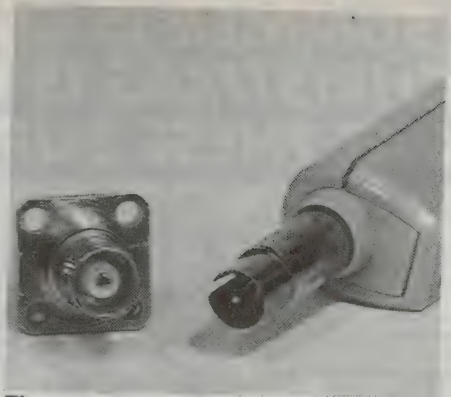
The quoted specs for the VOS 107 are quite impressive, although needless to say they're somewhat less rigorous than a full-blown analyser. The frequency range is rated as from 'less than 1MHz to more than 100MHz', with a horizontal linearity of +/–10%. It has a high input impedance for low circuit loading, a minimum dynamic range of 50dB, a vertical logarithmic linearity of +/–3dB and an IF bandwidth of 180kHz (–3dB). Vertical output is typically 5mV/dB, while the tangential sensitivity is 100uV at 50MHz, +/–3dB.

Flatness over the input frequency range from 5 – 100MHz is quoted as +/–2dB, while the LF degradation (below 1MHz) is given as 'approximately 8dB'. Sweeping rate is fixed at approximately 6ms for the 100MHz range.

The probe's spurious responses are rated at 'generally – 40dB', while radiation from its own internal sweeping local oscillator are rated at –40dBm at 150MHz and –50dBm at 250MHz – both with the probe connected to a 50-ohm load circuit. The maximum rated CW input is +15dBm, or 1V at 100MHz.

Strictly speaking the probe/scope combination is not capable of being calibrated in absolute terms, but Smith Design suggests that for a lot of common applications, a standard signal generator can be used to identify both frequencies and amplitudes to within about 0.1MHz and 1dB, by substitution.

To make this and other measurements in 50-ohm circuits more convenient, the VOS 107 comes with a 'BNC adaptor' sleeve, which allows the probe tip to be effectively converted into a BNC plug. A BNC 'T adaptor' can then be used to connect it to both a signal generator and a 50-ohm dummy load, for example.



The probe comes with a small adaptor, which effectively converts its tip into a plug for mating with a normal BNC socket.

Checking it out

The local distributors for Smith Design are Emona Instruments, who very kindly loaned us a sample VOS 107 to try it for ourselves. We tried it with a couple of standard scopes, one in the *EA* lab and the other in my own home workshop.

In both cases it hooked up very easily, and it was a matter of only a few seconds to bring up the expected analyser display. In fact hooking a short length of wire to the probe tip as a crude 'antenna' immediately brought up a dynamic picture of the Sydney airwaves from about 500kHz to 100MHz, with the AM stations clearly visible at the low end, ABN channel 2's vision and sound carriers prominent at 63-70MHz and the lower FM stations visible at far right. There was also a small collection of spikes bobbing up and down around 27MHz (presumably CB'ers), and a few more from low-band mobiles around 80MHz.

Using a signal generator and dummy load we were able to check the sweep range and linearity along both the frequency and log amplitude axes, and the results were really quite impressive. The range extended to just over 100MHz (102.1MHz, in fact), while the horizontal linearity was well within the rated +/–10%; in fact it was within 6MHz at all points, tending to read high at frequencies below about 55MHz, and low for frequencies above this figure. The vertical log calibration was well within the quoted figure of +/–3dB, and covered almost 60dB with very close to 10dB per 50mV scope division.

Out of curiousity we also tried getting a narrower effective sweep range, by using either a faster sweep rate or the scope's 'x10' horizontal sweep magnifier switch. In one case we were able to get an effective range of 0 – 50MHz, and in the other a range of 0 – 10MHz. These took a little fiddling with the scope's triggering controls to get a steady display, but apart from this they seemed to be quite practical as 'bonus' ranges. In both cases the frequency linearity was at least as good as that on the main 0 – 100MHz range, with the 0 – 10MHz range being within about 150kHz at each MHz point.

Incidentally we couldn't resist prising open the sample probe, to sneak a look at the innards. All that we found was a long thin PCB, with three 16-pin ICs and four transistors, and a fair number of passive components. It was all too compressed to work out the details, but our impression is that there are two internal oscillators – both working well above 100MHz and with one fixed as a 'zero reference'. Presumably the other is swept up and down over a 100MHz-plus range, to heterodyne against both the other and the input signals and feed the result through a logarithmic IF/detector system. Very ingenious, and it obviously works well!

Summary

Overall we found the VOS 107 Spectrum Probe a very impressive little performer. It's obviously not the equivalent of a fancy spectrum analyser with all the traditional bells and whistles, but it *does* allow very practical analysis of the spectrum up to 100MHz in a straightforward and repeatable fashion. And its calibration in terms of both frequency and amplitude is surprisingly good.

Our impression is that it's all many people would need to check spurious signals and interference from domestic equipment, monitor HF radio transmitters and transceivers for modulation and harmonic output, check the response of preamps and converters, check crystal oscillators for operation on the correct overtone, and a host of other worthwhile uses.

Last but by no means least, at the quoted price of $399 including tax it's certainly a lot more affordable than a full-scale analyser! Our thanks to the nice people at Emona, for giving us the opportunity to try one out.

For further information on the VOS 107 Spectrum Probe, circle 205 on the Reader Service Coupon, or contact Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933.

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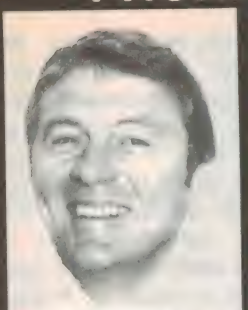

Jack O'Donnell
Managing Director

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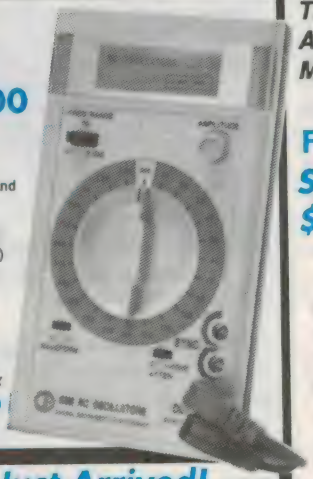

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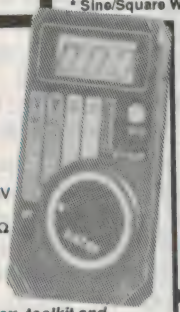

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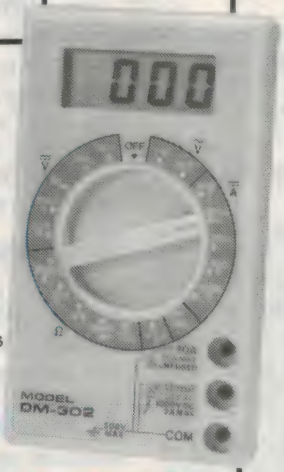
NEW FOR CHRISTMAS

Terrific New 18 Range Digital Multimeter *From World Famous Labtech Instruments*



* 3.5 Digit LCD * Compact Design 128 x 75 x 24mm * DC Voltage 5 Ranges: 100uV to 1000V * Input Impedance: 1MΩ * DC Current 6 Ranges; 0.1uA to 10A * Overload Protection * Resistance Measurement 5 Ranges; 0.1Ω to 2000kΩ

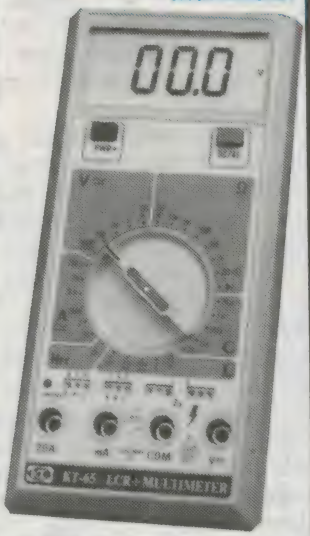
Q 1054 Multimeter **$39.95**

Q 1057 Carry Case $12.50

Another Altronics Price Breakthrough Great For The Christmas Stocking!

Just Arrived!

Great New Inductance Capacitance Digital Multimeter

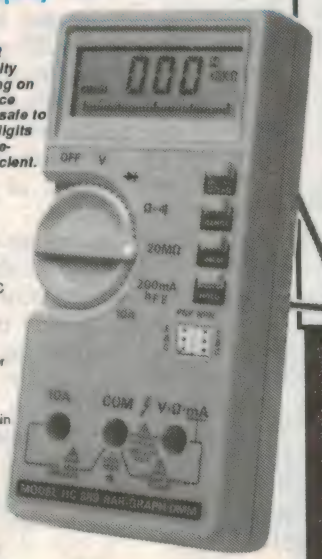


This truly fantastic bench Digital Multimeter + LCR, with capacitance and inductance ranges, enables you to test a wide variety of components. Indispensible for the design engineer, technician and enthusiast alike.

- 3.5 Digit LCD ● Tiltstand on Desktop
- DC Voltage 5 Ranges 100uV to 1000V
- DC Current 6 Ranges 100nA to 20A
- AC Voltage 5 Ranges 100uV to 750V
- AC Current 6 Ranges 100nA to 20A
- Resistance 7 Ranges 100mΩ to 200MΩ
- Input Impedance 10MΩ
- Capacitance 5 Ranges 1pF to 20uF
- Inductance 5 Ranges 1uH to 20H
- Diode Test ● Continuity Test With Buzzer
- Transistor Test (hFE)

Q 1062 Multimeter **$149.00** Includes Deluxe Carrying Case

Great New Digital Multimeter With Bar Graph Display



This popular 3.5 digit Multimeter is simplicity itself. Full autoranging on voltage and resistance measurements, and safe to use. The large LCD digits make taking measurements quick and efficient.

● 3.5 Digit LCD ● Bar Graph Display ● Continuity Check With Buzzer ● Tilt Stand on Desktop ● Data Hold Function ● Minus Memory to Nullify ● DC Volt/AC Volt, 100uV-1000V ● 10MΩ Input Impedance ● Low Battery Indicator ● Sample Rate Twice Per Second ● DC/AC Current 100uA-10A ● Resistance: 0.1Ω to 20MΩ ● Transistor Gain hFE ● Diode Checker

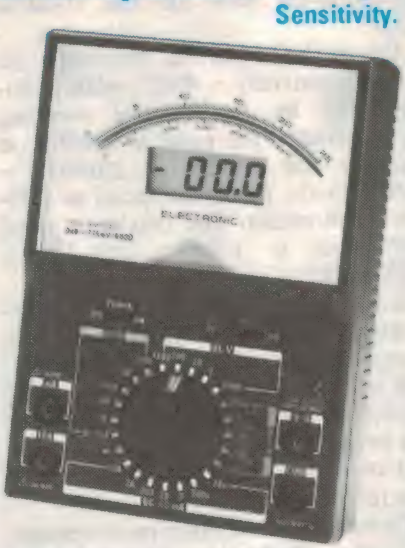
New This Month!

Q 1078 Multimeter
$119.00

Q 1076 Carry Case $12.50 Q 1077 Holster Holder $12.50

At Last! A True Rms Analog Digital Multimeter At A Very Competitive Price

A Great New Instrument Which Combines Digital Ease With Analogue Sensitivity.



● True RMS AC ● dB Meter -45dB to + 50dB ● 10MΩ Input Impedance ● 3.5 Digital Display ● 4.5" Analog Meter ● DC Volt/AC Volt 100uV-1000V ● DC Amp/AC Amp 0.01uA-10A ● Resistance 0.1Ω-20MΩ ● Diode Check ● Continuity Check with Buzzer ● Automatic Polarity Reversal ● Low Battery Indicator

New Product!

Q 1090 Multimeter **$199.50**

MONITOR THESE METER SPECIALS FOR CHRISTMAS!

PHONEORDER TOLL FREE ALTRONICS 008 999 007

PHONEORDER TOLL FREE ALTRONICS 008 999 007

FANTASTIC SPECIALS THIS MONTH

HIGH TECH Company Collapse Brings Fantastic Bargains for the Electronic Enthusiast

*"Viatel" (now "Discovery") SENSATION!

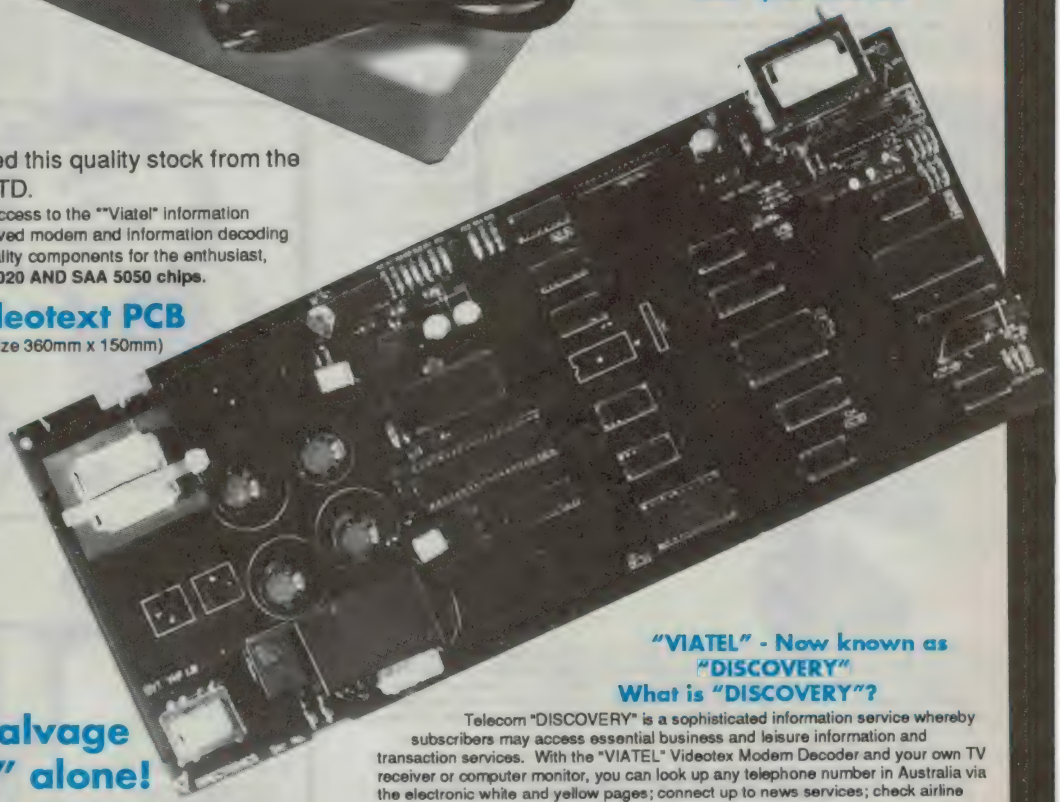
UNBELIEVABLE VALUE!
Around $250.00 value for as low as $24.00!

Altronics has recently purchased this quality stock from the liquidator of DTX AUSTRALIA LTD.

You can use this equipment to gain limited access to the *"Viatel" information system. Each unit contains a Telecom approved modem and information decoding circuits. The single PCB is a goldmine of quality components for the enthusiast, **including the fantastically valuable SAA 5020 AND SAA 5050 chips.**

ALL STOCK BRAND NEW PREMIUM QUALITY INDIVIDUALLY TESTED BY THE MANUFACTURER
(in our rush to get this amazing SCOOP PURCHASE to you we have not had time to check each unit so we cannot offer any warranty)

Videotext PCB
(Size 360mm x 150mm)



Worth well over $150.00 for the salvage value of the "bits" alone!

"VIATEL" - Now known as "DISCOVERY"
What is "DISCOVERY"?

Telecom "DISCOVERY" is a sophisticated information service whereby subscribers may access essential business and leisure information and transaction services. With the "VIATEL" Videotex Modem Decoder and your own TV receiver or computer monitor, you can look up any telephone number in Australia via the electronic white and yellow pages; connect up to news services; check airline schedules; pay bills or go shopping. You can even go to the bank without leaving the comfort of your own home. At the push of a button, you can check the weather or place a bet.

Look at this list of component parts!

- **Mains Transformer** - 240-9/15/24V 300mA
- **Line Isolation Transformer** - Telecom approved 600/600 Ohm or 600/150 Ohm impedance.
- **Video/RF Modulator** (Channel 0)
- **Low profile** 12V 5A SPDT Relay
- **Capacitor** - 2.0uF 440V AC
- **Crystals** - 6MHz and 4.43MHz
- **TTL, CMOS**, Linear and LSI ICs - SAA 5020, SAA 5050, 2516 and many more
- **Voltage regulators** ● Bridge rectifiers ● Trimpots and capacitors ● Filter capacitors ● Flatpack heatsink I Plus much, much more!

VIATEL VIDEOTEX MODEM DECODER

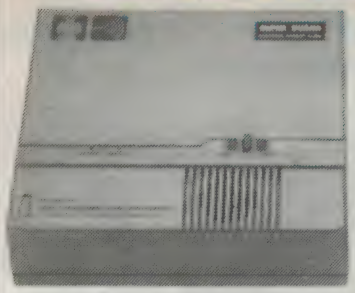
Four models to choose from; Each with a numeric keypad.

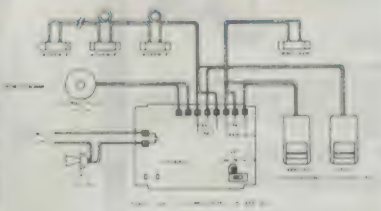
		1 to 5 each	6 or more each
X 1000	WITH RF OUTPUT	$29.95	$23.95
X 1002	WITH RF OUTPUT AND TELEPHONE HANDSET	$34.95	$27.95
X 1004	WITH RF AND RGB VIDEO OUTPUT	$34.95	$27.95
X 1006	WITH RF AND RGB VIDEO OUTPUT AND TELEPHONE HANDSET	$39.95	$31.95

* "Viatel" is now "Discovery 40/80"

PHONEORDER TOLL FREE ALTRONICS 008 999 007

SUPER GUARD HOUSEHOLD ALARM SYSTEM





- Easy to operate Simplicity itself - just select the switch to Home, Off or Away as desired. A 45 second exit/entry delay allows you to vacate and/or re-enter your premises and disarm the system.
- No key switches or code buttons to push. Thus the system is ideal for families - even the kids can operate this system.
- Facility for external siren
- Battery back-up (battery 8'C'cells not included)

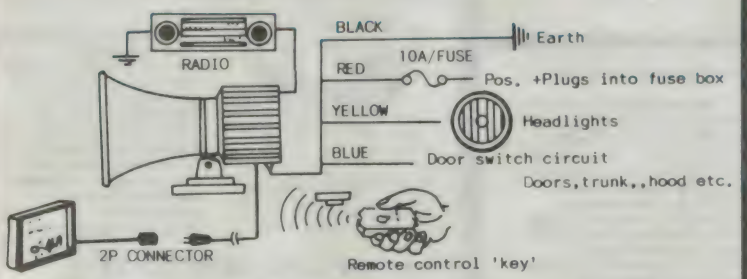
System Contents
● Master Control Unit ● Front Door Bell Switch ● Panic/Emergency Switch ● Three Window/Door Reed Switches ● Mounting Hardware ● 20 Metres Wire ● Instruction Manual

FANTASTIC VALUE Complete System
S 5465 Normally $129.00

THIS MONTH ONLY $99.00

HIGH POWER CAR ALARM

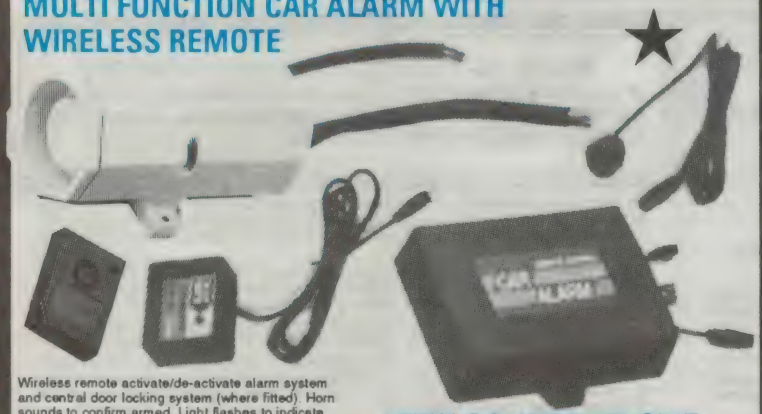
With Wireless Remote Control



This alarm system will be triggered by unauthorised entrance through the car doors, boot, bonnet or removal of the car sound unit. The siren will sound and the headlights flash for 60 seconds.
Simple wiring, wire it yourself without professional assistance.
Automatic Reset

S 5220 **ONLY $99.00** High Performance

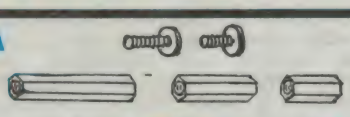
MULTI FUNCTION CAR ALARM WITH WIRELESS REMOTE



Wireless remote activate/de-activate alarm system and central door locking system (where fitted). Horn sounds to confirm armed. Light flashes to indicate disarmed.
Comprehensive system protects from:
● Bumping of car body ● Towing ● Window breaking ● Forced entry of door boot or bonnet.

VERY COMPREHENSIVE
S 5225 ***$129.00*** **Direct Import Price!**

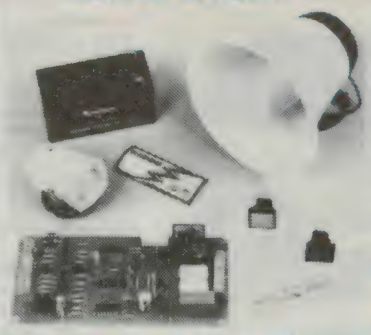
AMAZING SAVINGS ON 4BA SPACERS AND SCREWS!!!



Cat No.	Item	Size	Qty per pack	Normally	Clear out Price	10 or more
H 1195	R/HD SCREW	6mm	25	$2.50	$1.20	$1.00
H 1196	R/HD SCREW	6mm	100	$4.30	$2.30	$2.00
H 1197	R/HD SCREW	10mm	25	$2.60	$1.30	$1.20
H 1198	R/HD SCREW	10mm	100	$4.70	$2.30	$2.00
H 1385	SPACER TAPPED	10mm	8	$2.60	$1.20	$1.00
H 1386	SPACER TAPPED	10mm	100	$11.30	$6.00	$5.00
H 1387	SPACER TAPPED	15mm	8	$2.65	$1.20	$1.00
H 1388	SPACER TAPPED	15mm	100	$12.20	$6.50	$5.50
H 1389	SPACER TAPPED	25mm	100	$20.30	$10.00	$9.00

The Protector Car Alarm

BONUS OFFER!!!

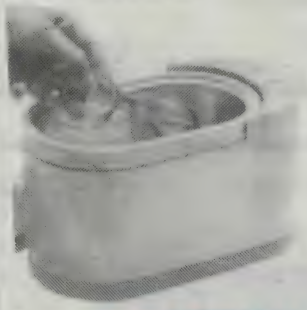


(See SC Feb'88)
This refined car burglar alarm has about every feature you could possibly want to keep would be thieves away.
FEATURES: ● Internal & External Sirens ● Dash lamp flasher ● Battery back up ● Delayed & Non delayed inputs ● Ignition killer ● Easy to build and install.

K 4370
NORMALLY $129.00
THIS MONTH ONLY $119.00 SAVE $10.00

Earns its cost hunderds of times over in cleaning connectors, PCB's, switches, jewellery, glasses, watches, drafting pens, etc. Awarded the Good Product Design Award for CETDC in 1987

Pin Point ULTRASONIC CLEANER

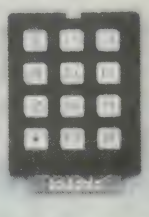


Will even clean your teeth!
Won't scratch or damage - uses ordinary tap water and creates millions of super-penetrating bubbles. Hospital tests show that Ultrasonic cleaning produces better results safer than conventional methods.

In just 3 minutes you will be amazed at the difference!

TOP VALUE

A 0100 NORMALLY $199.00,
ONLY ***$174.00*** THIS MONTH



FOUR DIGIT COMBO LOCK

DESIGNED BY ALTRONICS

Yes! That's right, this four digit combination lock was designed from the ground up by the ALTRONICS R&D DEPARTMENT to exactly satisfy your security requirements.
Ideal for use in alarm systems, solenoid operated doors and all systems requiring security access.
Features: ● Single PCB construction ● Fits into standard GPO wall box ● Over 14 000 possible combinations ● 5 second combination entry time ● Code easily changed via DIP switches ● Latched or momentary output ● Optional battery back-up

K 1925 ***$39.95***
Build your own security

FANTASTIC! SOLENOID OPERATED DOORLOCK

8-12V DC OPERATION

Increases home security and garden privacy. Control your front door from lounge, kitchen or bedroom or anywhere you like. Comes complete with two face plates for either concealed or visible fitting.

S 4390
$39.95

21st Century entertainment — fascinate your friends this Christmas!

PLASMA LAMP DISPLAY

Amazing! Pulsating high voltage plasma discharge continually changes shape and direction. Mode selectable to either fingertip control or sound activated. For example, from voice or sound system. Provides endless fascination as it sizzles and arcs.
Supplied complete with AC mains adaptor.
Imagine getting one for Christmas!

A 0120 Normally $199
SAVE $50.00

Up till now similar lamps have sold for $1000 and more!!

THIS MONTH ONLY $149.00

PHONEORDER TOLL FREE ALTRONICS 008 999 007

240V VOLTAGE INVERTERS

Get 240V Mains Power from your battery with these handy DC to Ac inverter kit sets

Many combinations to choose from

300 Watt Inverter with Auto Start

Operates from 12V Car Battery

Auto start draws power from your battery only when appliance is plugged in and "turned on", that is battery can be left permanently connected if required. ● Voltage regulated ● Current regulated ● Current Overload unit self limits.

Complete kit K 6750 **$279.00**

Fully built and tested K 6755 $379.00

100's of uses at home and away.

POWERHOUSE 600W INVERTER (See EA Dec '87)

This nverter has the capacity to produce 600 watts od mains power which will run a fantastic array of appliances. Ideally suited to running power tools, lighting (including fluros) electric motors and much more. It can be used as a portable or permanent fixture.

● Manual or Auto Start facilities ● Low battery cut-out.

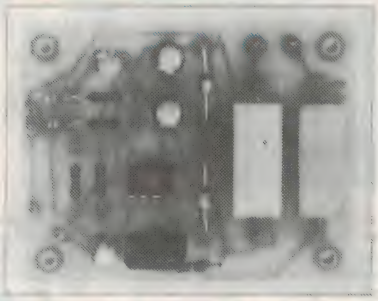
Kit Version K 6770 **$425.00**

Fully built and tested 12V Input K 6774
24V Input K 6775 $525.00

GREAT SAVINGS!!!

WANT MORE POWER FROM YOUR AMPLIFIER? — LOOK AT THIS!!

BRIDGE ADAPTOR FOR STEREO AMPLIFIERS (See EA June '85)



NEW THIS MONTH!

This simple circuit makes it possible for any stereo amplifier to deliver four times the single channel power into the same single load. Frequency response is 10Hz to 300kHz and harmonic distortion is less than 0.001% at 8V RMS.

K 5565 **$15.95** ***VALUE***

DISCOLITE (See Silicon Chip July/Aug '88)

Great for parties, shop displays and special lighting effects

The DISCOLITE flashes party lights on and off in beat with the music from your sound system. ● 4 light channels contrlled by 4 seoarate audioe channels ● Forward, reverse & auto-reversing chaser patterns ● Simultaneous strobe on all 4 channels ● Alterr.ating light patterns ● Music modulation available on chaser strobe and alternate patterns ● inbuilt microphone for beat triggering or audio modulation of lights ● Direct inputs ● Sensitivity control ● Presettable sensitivity levels for each channel ● Front panel LEDs mimic light display ● Altronics kit pre-punched and screened

K 5805 **$159.50**

Beat Triggered Strobe (See AEM July 1985)

Add some life to your next party Designed by Australian Electronics Monthly. Flashes in time to your music plus it will work as a normal strobe. Exclusively customised by Altronics into our H 0480 instrument case, making construction a breeze and improving stability and overall appearance. Includes silk screened panel.

K 5790 Was $79.95

Now $70.00 SAVE $10.00

For Increased power two tube option
K 5795 $16.50

● BANKCARD ● VISA ● MASTERCARD ● PHONE TOLL FREE 008 999 007
● NEXT DAY JETSERVICE DELIVERY
Country clients please allow an additional 48-72 hours

ALTRONICS

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Perth Metro (09) 328 1599
ALL MAIL ORDERS
P.O. Box 8350 Stirling Street Exchange Perth W.A.6000

MORE ALTRONICS DEALERS WANTED

If you have a Retail Shop, you could increase your income significantly by becoming an Altronics Dealer, Phone Chris Campbell (09) 328 2199 for Details.

ALTRONICS RESELLERS

Chances are there is an Altronics Reseller right near you - check this list or phone us for details of the nearest dealer. **Please Note:** Resellers have to pay the cost of freight and insurance and therefore the prices charged by individual Dealers may vary slightly from this Catalogue - in many cases, however, Dealer prices will still represent a significant cost saving from prices charged by Altronics Competitors.

Don't forget our Express Mail and Phone Order Service - for the cost of a local call, Bankcard, Visa or Mastercard holders can phone order for same day despatch.

Blue Ribbon Dealers are highlighted with a ■. These Dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

STANDARD DELIVERY & PACKING CHARGE $5.50 to 1Kg $8 over 1Kg AUSTRALIA WIDE — We process your order the day received and despatch via. Australia Post. Allow approx 9 days from day you post order to when you receive goods

OVERNIGHT JETSERVICE Up to 3 Kg is $8.00 - 3Kg to 5Kg is $20.00 — We process your order the day received and despatch via. **Overnight Jetservice Courier** for delivery next day Country areas please allow additional 24-48 hours.

HEAVY HEAVY SERVICE — All orders of 10Kgs or more must travel Express Road - Please allow 7 days for delivery. $12.00 to 10Kgs, $15.00 over 10Kgs.

INSURANCE — As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add 1% to order value (minimum charge $1). When phone ordering please request "Insurance".

TOLL FREE PHONE ORDER — Bankcard,Visa, Mastercard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

WA COUNTRY **ALBANY** BP Electronics ■ 412681 **ESPERANCE** Esperance Communications 713344 **GERALDTON** Bird Electronics 641631 **KALGOORLIE** Todays Electronics ■ 212777 **PORT HEADLAND** Ivan Tomek Electronics 732531 **WYALKATCHEM** D & J Pease 811132 **NT** **ALICE SPRINGS** **Farmer Electronics 522388** **DARWIN** Ventronics 853622 **ACT** **CANBERRA** Bennett Commercial Electronics 805359 **VICTORIA CITY** All Electronic Components 6623506 The Electronic Component Shop ■ 6706474 **SUBURBAN** **CHELTENHAM** Talking Electronics 5842386 **CROYDEN** Truscott Electronics ■ 7233860 **PRESTON** Preston Electronics ■ 4840191 **COUNTRY** **BENDIGO** KC Johnson ■ 411411 **SHEPPARTON** Tattersal Sounds 8212892 **MILDURA** McWilliam Electronics 236410 **WARRNAMBAL** Kovoit Electronics 627417 **QUEENSLAND CITY** Delsound P/L 8396155 **SUBURBAN** **CAPALABA** Kingsway Electronics 3902399 **WOODRIDGE** David Hall Electronics 8082777 **COUNTRY** **BUNDABERG** Bob Elkins Electronics 721785 **GLADSTONE** Supertronics 724459 **MACKAY** Philtronics ■ 578855 **ROCKHAMPTON** Access Electronics (East St.) 221058 **TOOWOOMBA** Hunts Electronics ■ 329677 **TOWNSVILLE** Solex ■ 7724466 **MAROOCHYDORE** Mals Electronics 436119 **SA CITY** Force Electronic ■ 2125505 **SUBURBAN** **BRIGHTON** Force Electronics ■ 3770512 **CHRISTIES BEACH** Force Electronics ■ 3823366 **ENFIELD** Force Electronics ■ 3496340 **FINDON** Force Electronics ■ 3471188 **LONSDALE** Force Electronics ■ 3260901 **COUNTRY** **MT.GAMBIER** South East Electronics 250034 **WHYALLA** Eyre Electronics ■ 454764 **TASMANIA** **HOBART** George Harvey ■ 342233 **LAUNCESTON** George Harvey ■ 316533 **NSW** **CITY** David Reid Electronics ■ 2671385 **CARINGHAH** Hicom Unitronics 5247878 **BLACKTOWN** Sheridan Electronics 621 1494 **COUNTRY** **COFFS HARBOUR** Coffs Habour Electronics 525684 **GOSFORD** Tomorrows Electronics 247246 **GRAFTON** East Coast Electronic 431250 **NEWCASTLE** Novocastrian Elect.Supplies 621358 **RAYMOND TERRACE** Alback Electronics 873419 **WINDSOR** M & E Electronics 775935 **WOLLONGONG** Newtek Electronics ■ 271620 Vimcom Electronics 284400 **WAGGA WAGGA** Phillips Electronics 216558

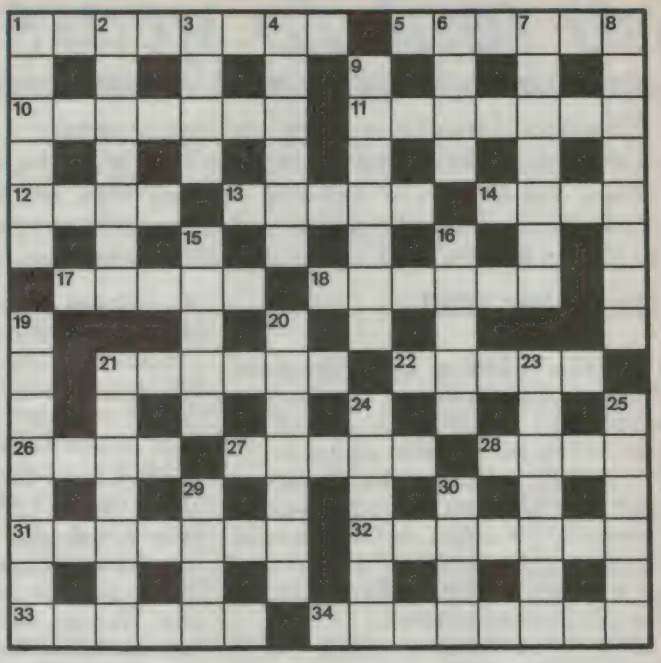
EA CROSSWORD

Across

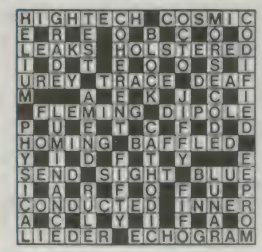
1. Said of system with no non-function danger. (4-4)
5. First name of Edison. (6)
10. Product of force and time. (7)
11. Swedish astronomer and inventor of temperature scale. (7)
12. Electrode with mesh structure. (4)
13. What an electric arc does in a workshop. (5)
14. Nature of poles that repel. (4)
17. Pick-up tips. (5).
18. Sequence of items. (6)
21. Trig function. (6)
22. Unwanted signals. (5)
26. Units derived from SI. (4)
27. Use for synthesiser. (5)
28. Colloquial term for erase. (4)
31. Logic term for proof where alternative is false. (7)
32. Insulating eyelet. (7)
33. Background vibrations. (6)
34. Type of telephone system. (8)

Down

1. Edge of TV reception zone. (6)
2. Make a picture, pattern, etc., on something. (7)
3. Electromagnetic phenomenon, ---- -inductance. (4)
4. HT power cable. (6)
6. Name of a magnetic effect. (4)
7. Distributing by post. (7)
8. Mounts a needle. (8)
9. What a pH meter can measure. (7)
15. Kind of circuit. (5)
16. French inventor of instrument for measuring fluid velocity. (5)
19. One thousand bits per second. (8)
20. Generated. (7)
21. Such are cassettes. (7)
23. Type of shock. (7)
24. First part of switching term SP. (6)
25. Radiator. (6)
29. Second part of the term SP. (4)
30. Type of capacitor. (4)



SOLUTION TO OCTOBER



Electronics Australia with eti

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Note to the Editor:

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For publication! Yes/NO

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Address: .....

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Postcode:.....

50 and 25 years ago..

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

November 1940

Photo-electric Pick-up Uses Light Beam: A new type of photo-electric pick-up for which many nice things are claimed has been developed by Philco engineers.

One of the features is that the pick-up may be dropped on the record without damage to the stylus, as this is a small sapphire point mounted on a spring strip, which is able to flex vertically, though rigid horizontally.

This stylus drives a mirror, which measures about 3/8 inch by 5/8 inch, and is pivoted top and bottom. A beam of light from a special concentrated filament bulb is brought through a pair of condenser lenses and cast upon the mirror.

From there it is reflected to a photoelectric cell, the end of which is so masked that about half the light beam strikes the sensitive portion of the cell.

When the stylus causes the mirror to vibrate as driven by the grooves in the record, a greater or lesser amount of light falls on the PE cell, and thus generates a fluctuating voltage which is fed into a high gain amplifier.

New Broadcaster in WA: A broadcasting station of latest design and construction is about to be established at Merredin, Western Australia, by WA Broadcasters Ltd which company has instructed Amalgamated Wireless to supply and install the requisite equipment.

Amalgamed Wireless has designed a 500-watts station of the modern class B modulated type and it will operate on a wavelength of 273 metres (1100 kilocycles) on the quarter wave radiating principle; that is to say the single mast employed as aerial will be one-fourth of 273 metres in height, namely 224ft.

The Merredin station will be on the air towards the end of the year.

November 1965

25" TV Receivers for Schools: The latest type of 25-inch receivers, specially developed for viewing television sessions organised by the Australian broadcasting Commission and the Department of Education, have been ordered by the Department for secondary schools in NSW.

The order has been placed with Amalgamated Wireless (A'sia) Ltd whose 23-inch television receivers are already operating in about 160 departmental secondary schools in the Sydney metropolitan area and the country for viewing mathematics and science programs.

The receiver is mounted on a wheel-about frame designed so that the centre of the picture is five feet from the floor and the picture is tilted downwards towards the class for improved viewing.

The NSW Department of Education is again subsidising 20% of the cost of receivers for departmental secondary schools.

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DESCRIPTION	1-9	10+
4164-10 (64K x 1)	$3.50	$3.00
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41256-08 (256K x 1)	$3.95	$3.50
44256-08 (256K x 4)	$12.95	$11.95
411000-08 (IMEG x 1)	$12.95	$11.95

VOLTAGE REGULATOR BARGAINS

DESCRIPTION	1-9	10+
7805UC	$0.50	$0.45
7812UC	$0.50	$0.45
7815UC	$0.50	$0.45
7905UC	$0.60	$0.55
7912UC	$0.60	$0.55
7915UC	$0.60	$0.55
LM317T	$1.00	$0.90
LM337T	$2.10	$2.00

LINEAR

DESCRIPTION	1-9	10+
TL061	$0.95	$0.90
TL072	$1.10	$1.00
TL084	$1.80	$1.70
1458	$0.50	$0.45
1488	$0.50	$0.45
1489	$0.50	$0.45
LM324	$0.60	$0.55
LM339	$0.60	$0.55
LF353	$0.90	$0.85
LM358	$0.45	$0.40
LM3900	$1.20	$1.10
555	$0.40	$0.38
741	$0.50	$0.45

DIODES

DESCRIPTION	1-9	10+
IN4148	$0.04	$0.03
IN4004	$0.05	$0.04
IN5404	$0.15	$0.12

BRIDGES

DESCRIPTION	1-9	10+
W04	$0.45	$0.40
BR104: 10A 400V	$1.80	$1.50
BR354: 35A 400V	$3.90	$3.00

Z80

DESCRIPTION	1-9	10+
Z80ACPU	$3.00	$2.50
Z80BCPU	$4.50	$4.00
Z80CCPU	$6.50	$6.00
Z80AP10	$3.00	$2.50
Z80BP10	$4.50	$4.00

TRANSISTORS

DESCRIPTION	1-9	10+
BC547	$0.10	$0.08
BC547C	$0.20	$0.15
BC548	$0.10	$0.08
BC548C	$0.20	$0.15
BC549	$0.10	$0.08
BC549C	$0.20	$0.15
BC557	$0.10	$0.08
BC557C	$0.20	$0.15
BC558	$0.10	$0.08
BC558C	$0.20	$0.15
BC559	$0.10	$0.08
BD139	$0.40	$0.35
BD140	$0.40	$0.35
TIP31C	$0.80	$0.75
TIP32C	$0.80	$0.75
2N3055	$1.25	$1.15
2SJ56	$9.50	$8.50
2SK176	$9.50	$8.50

CMOS

DESCRIPTION	1-9	10+
4001B	$0.25	$0.20
4011B	$0.25	$0.20
4013B	$0.25	$0.20
4016B	$0.40	$0.30
4026B	$0.90	$0.80
4042B	$0.50	$0.45
4044B	$0.80	$0.75
4049B	$0.50	$0.45
4053B	$0.80	$0.75
4060B	$0.70	$0.65
4069B	$0.40	$0.35
4071B	$0.40	$0.35
4081B	$0.40	$0.35
4093B	$0.65	$0.60

74F

DESCRIPTION	1-9	10+
74F00	$0.50	$0.45
74F04	$0.60	$0.55
74F08	$0.50	$0.45
74F74	$0.60	$0.55
74F86	$0.80	$0.75
74F138	$0.95	$0.90
74F175	$1.50	$1.40
74F574	$2.50	$2.00

74LS

DESCRIPTION	1-9	10+
74LS00	$0.25	$0.20
74LS04	$0.25	$0.20
74LS06	$1.20	$1.10
74LS08	$0.25	$0.20
74LS11	$0.65	$0.60
74LS14	$0.70	$0.65
74LS27	$0.75	$0.70
74LS32	$0.55	$0.50
74LS38	$0.75	$0.70
74LS47	$1.50	$1.40
74LS73	$0.95	$0.90
74LS74	$0.95	$0.90
74LS83	$1.10	$1.00
74LS85	$0.80	$0.75
74LS86	$0.55	$0.50
74LS90	$1.10	$1.00
74LS93	$1.20	$1.10
74LS95	$1.10	$1.00
74LS107	$0.85	$0.80
74LS112	$0.65	$0.60
74LS123	$1.20	$1.10
74LS125	$0.90	$0.80
74LS126	$0.95	$0.90
74LS132	$0.95	$0.90
74LS138	$0.55	$0.50
74LS139	$0.75	$0.70
74LS148	$1.70	$1.60
74LS151	$1.20	$1.10
74LS157	$1.20	$1.10
74LS160	$1.40	$1.30
74LS163	$1.10	$1.00
74LS164	$1.40	$1.30
74LS165	$1.20	$1.10
74LS173	$1.20	$1.10
74LS174	$1.00	$0.90
74LS175	$0.70	$0.60
74LS194	$1.20	$1.10
74LS240	$1.40	$1.30
74LS244	$1.10	$1.00
74LS245	$1.10	$1.00

7400

DESCRIPTION	1-9	10+
7400	$0.80	$0.75
7401	$0.80	$0.75
7402	$1.00	$0.80
7403	$1.00	$0.95
7404	$1.00	$0.95
7405	$1.00	$0.95
7406	$1.00	$0.95
7407	$1.20	$1/10
7408	$1.00	$0.95
7409	$1.00	$0.95
7410	$1.20	$1.10
7413	$1.00	$0.95
7414	$1.50	$1.40
7417	$0.90	$0.85
7421	$1.00	$0.95
7423	$1.40	$1.30
7425	$1.20	$1.10
7427	$0.90	$0.85
7430	$1.00	$0.95
7432	$1.00	$0.95
7437	$1.00	$0.95
7440	$1.20	$1.10
7442	$1.50	$1.40
7447	$1.75	$1.65
7450	$0.90	$0.85
7453	$0.70	$0.65
7454	$0.80	$0.75
7460	$1.20	$1.10
7470	$0.80	$0.75
7472	$0.90	$0.85
7473	$1.20	$1.10
7474	$1.00	$0.90
7490	$1.20	$1.10
74132	$1.00	$0.90
74365	$2.10	$1.95

DESCRIPTION	1-9	10+
74HC00	$0.75	$0.65
74HC02	$0.75	$0.65
74HC04	$0.75	$0.65
74HC08	$0.75	$0.65
74HC10	$0.75	$0.65
74HC14	$1.50	$1.40
74HC20	$0.85	$0.80
74HC30	$0.60	$0.50
74HC32	$0.80	$0.75
74HC42	$1.20	$1.10
74HC73	$1.20	$1.15
74HC74	$0.75	$0.65
74HC75	$1.20	$1.10
74HC76	$1.10	$1.05
74HC78	$1.40	$1.25
74HC83	$1.40	$1.30
74HC85	$1.40	$1.30
74HC86	$1.10	$1.00
74HC91	$1.10	$1.00
74HC93	$0.90	$0.85
74HC95	$1.45	$1.35
74HC107	$1.00	$0.95
74HC108	$1.10	$1.00
74HC109	$1.00	$0.95
74HC112	$1.00	$0.95
74HC113	$1.20	$1.10
74HC123	$1.30	$1.15
74HC125	$1.20	$1.10
74HC138	$1.20	$1.10
74HC153	$1.35	$1.25
74HC157	$1.25	$1.15
74HC163	$1.20	$1.10
74HC173	$1.20	$1.10
74HC174	$0.90	$0.80
74HC221	$1.45	$1.35
74HC240	$1.10	$1.00
74HC244	$1.10	$1.00
74HC245	$1.10	$1.00
74HC273	$1.20	$1.10
74HC365	$1.20	$1.10
74HC373	$1.20	$1.10
74HC374	$1.20	$1.00
74HC390	$3.80	$3.60
74HC393	$1.20	$1.10

WIRE WRAP IC SOCKETS

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8 pin	$1.50	$1.40
14 pin	$1.85	$1.75
16 pin	$1.95	$1.80
18 pin	$2.00	$1.90
20 pin	$2.95	$2.75
24 pin	$3.95	$3.50
28 pin	$4.00	$3.60
40 pin	$4.95	$4.50

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YELLOW	$0.15	$0.12	$0.10

QUALITY 3mm LEDS

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YELLOW	$0.20	$0.15	$0.12

RECTANGLE LEDS

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Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

Two-tone oscillator for SSB testing

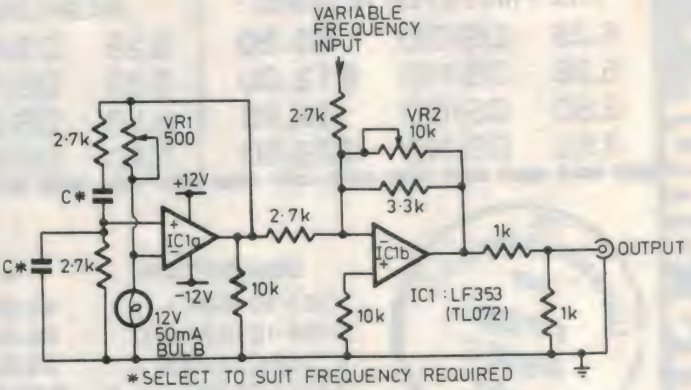
After building the Low Distortion Audio Oscillator in February and March 1989 *EA* I needed a two-tone oscillator for SSB transmitter adjustment. I came up with this add-on circuit and built it into the Audio Oscillator.

It uses an LF353 (TL072) dual op-amp. The first amp is used to produce a fixed tone, which is mixed with the variable tone from the oscillator – taken from the scope output.

The second op-amp is used to adjust the output, 10mV to 12V p-p, via VR2. Power to run the circuit is taken direct from the audio oscillator supply rails.

VR1 is adjusted so that the fixed tone level equals the level from the variable oscillator. The output is via a separate BNC socket.

This circuit is also useful in displaying Lissajous' figures on an oscilloscope.



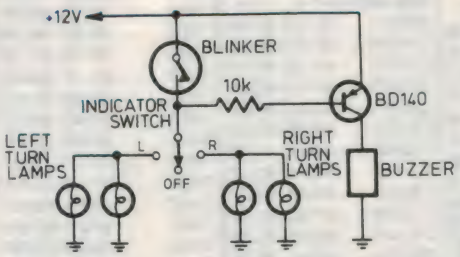
Peter Buckman,
Boggabri, NSW.

$40

Audio reminder for bike blinkers

I own a rather old motor bike, which is not fitted with self-cancelling turn indicators, so I decided to make a circuit which gives an audible reminder of the indicator/blinker operation. This simple circuit achieves the right result, with minimal change to existing wiring.

Only three additional components are used – a 12V piezo buzzer, a BD140 PNP power transistor and a 10k resistor. When the indicator switch is in the centre 'off' position, the base of the transistor is connected back to its emitter and the +12V line from the battery,



via the 10k resistor and the blinker unit. The transistor is therefore cut off.

When the indicator switch is moved to either the left or right turn positions, the switch rotor is connected to ground via the relatively low resistance of the indicator lamps. The lamp current then flows through the blinker, causing it to heat up. As usual the internal contacts then open and close, to produce the desired lamp flashing. However each time the blinker contacts open, the transistor's base is connected to ground via the 10k resistor and the lamps, turning it on and producing a 'beep' from the buzzer.

The buzzer continues to sound this audible warning as long as the indicator switch is left in either of the 'on' positions, only stopping when it is moved back to the centre 'off'.

I fitted the buzzer in the headlight case, to protect it from the weather.

Frank Patey,
Subiaco, WA.

$35

Improved ignition killer

Due to the high rate of car theft, it is a common practice to have a hidden shorting switch fitted across the points, as shown in Fig.1. A similar idea is employed for the *EA* Ignition Killer of February 1984.

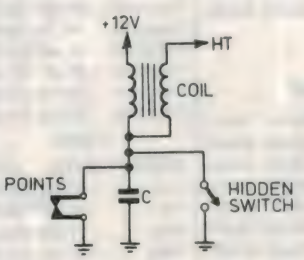
However the circuit shown will allow large currents to pass through the coil, which may cause serious damage – especially if the vehicle is fitted with electronic ignition. After all, if a thief fails to steal your car, (s)he will not hang around to make sure the hotwiring is disconnected! The *EA* killer alleviates some of this problem, by including a 15 ohm 10W resistor in series with the ground. But for total protection to the ignition system, it is better to use a capacitor to short out what is, in effect, an AC current. Thus the points are only shorted while the engine is attempting to run, while no current can flow with the engine stopped.

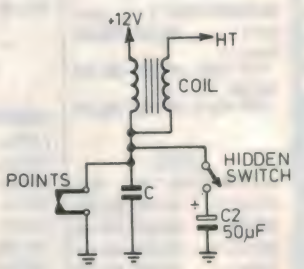
This is shown in Fig.2. A value of about 10uF upwards for C2 seems to suit most cars. Since voltage spikes on conventional points can reach 200-300 volts, C2 must be rated for at least 350V.

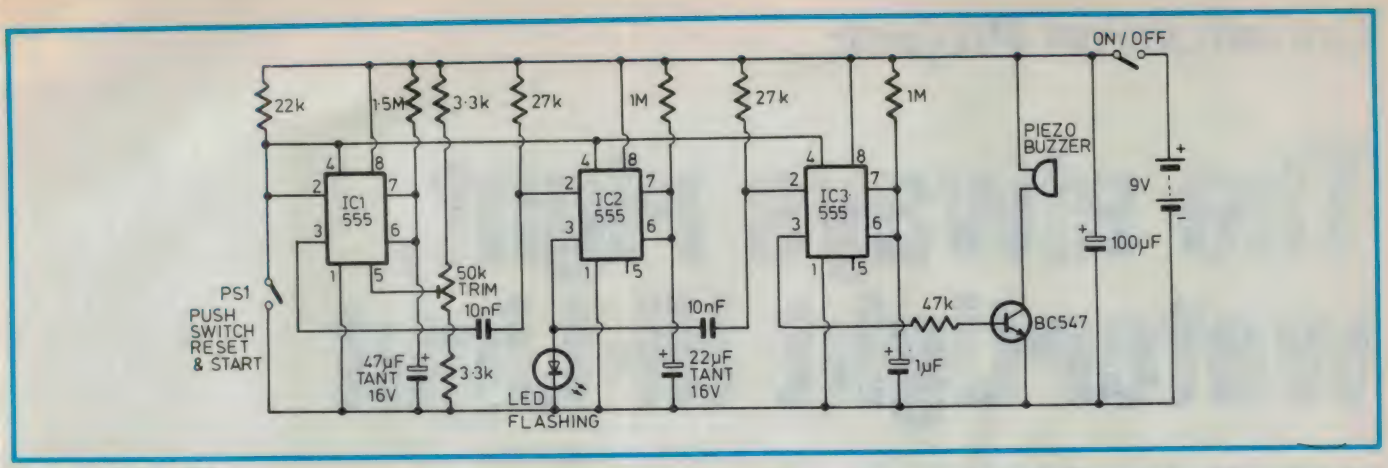
I prefer to use two 100uF/250V capacitors in series, which is cheaper and more readily available than say a 10uF/350V capacitor as well as giving 500V surge protection.

Leon Miguel,
Hope Valley, WA.

$30







Scrabble Timer

Scrabble, and other games that involve turns and time to think, can get a bit tedious if players take all day pondering their next play. This timer will help to jolly along such people by allowing a limited time for each play. It's up to the user to devise a penalty for anyone who doesn't start his play in the allotted time. When children play with adults perhaps the children could be allowed two time cycles and adults only one.

The timer has the following features:

(a) It is reset and started by only one push switch.

(b) About 25 seconds before the time expires, a LED flashes and continues to flash – to prompt urgent action

(c) At the end of the time a piezo buzzer sounds for about one second

(d) It takes very little current and can be operated from a nine volt battery.

The circuit comprises three 555 timers, each connected in the monostable mode. All the reset pins (pin 4) are connected together and to pin 2, the trigger pin, of IC1. A 22k pullup resistor acts for all of these pins. The push switch PS1 resets all three timers so that a player does not have to wait until the end of a previous player's time, before starting the timer. The same push switch starts the time period of IC1 by connecting pin 2 to the negative rail.

The duration of the first period is adjustable by the 50k preset pot connected to pin 5 of IC1. It was set to give a time of about 90 seconds. When that time expires, pin 3 of IC1 goes low and triggers IC2, sending its pin 3 high immediately. This starts the flashing LED flashing for about 25 seconds.

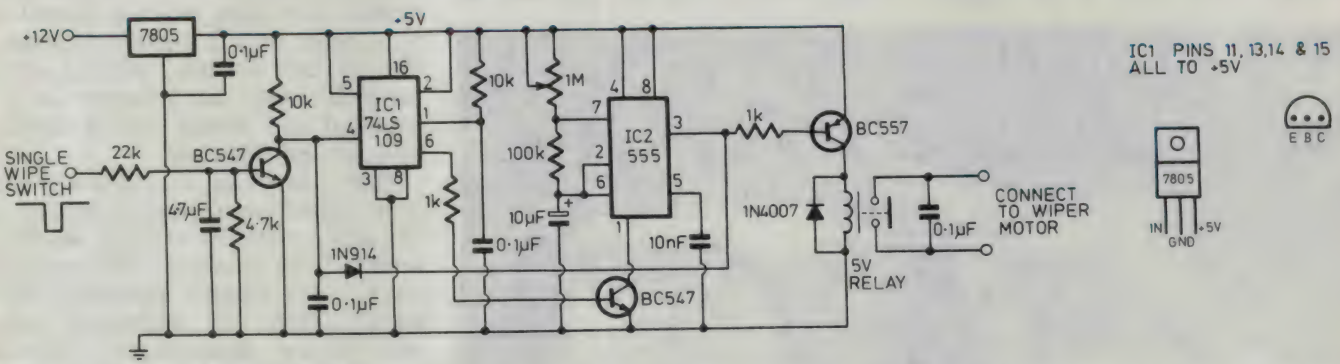
At the end of the period for IC2, its pin 3 goes low, thus triggering IC3. Pin 3 of IC3 goes high immediately and turns on the piezo buzzer for about one second, via the transistor. The loudness of the buzzer can be varied by changing the base resistor in the transistor circuit.

The original was constructed on Veroboard.

In use, the timer is placed where the LED can be seen by all players. It is operated by the score keeper who, after he has entered each score, resets and starts the timer. A fair go for all!

A.J. Lowe,
Bardon, Qld.

$40



'Easy-fit' wiper delay

This circuit has been designed to fit into a car's wiper circuit to provide a delayed wipe – without the need to mount an extra switch on the dashboard. The circuit is activated and deactivated by the momentary operation of an existing switch, such as that for a single wipe, (or as I used) the washer switch – which can then wash the windscreens at the same time.

The 74LS109 is a J-K flipflop configured so that when pin 4 is pulsed high, the output (pin 6) toggles. Upon power up, the preset (pin 1) forces pin 6 low, holding the rest of the circuit off so the wipers don't operate when the car is started.

The 555 timer produces the actual timing pulses, dependent upon the preset pot, and is started by its pin 1 being connected the ground by the BC547. Its output drives a relay which is connected to the wiper motor.

The 7805 regulator provides a stable 5 volt supply for the flipflop, but a zener diode could be used instead. The BC547 on the input to the flipflop acts to invert the input logic, because most cars' wiper switch terminations are live, and need to be grounded to activate the motor. The 4.7uF capacitor and 1N914 diode act to prevent false triggering caused by contact bounce. The relay needs to be a 5 volt miniature power type which are about $6 and readily available and can be PCB mounted.

Greg Peart,
Auckland, NZ

$40

Construction Project:

The always right, watertight Hi-Light

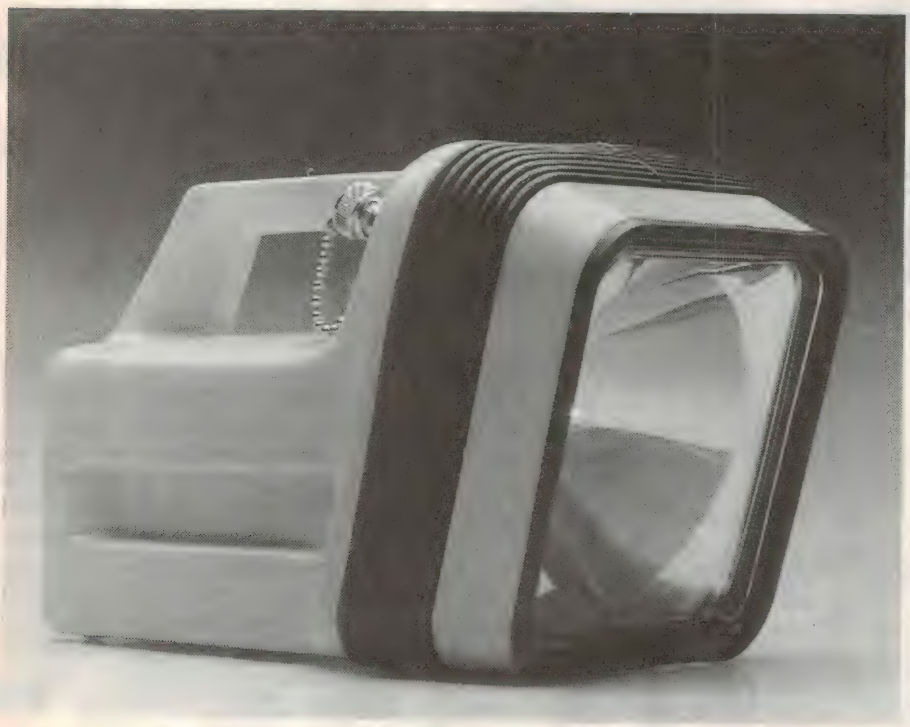
How many times have you gone to use your 'Dolphin' torch and found that the relatively 'new' battery in it was flat or virtually useless? If you're familiar with this scenario and resent having to pay good money for batteries, then this is the project for you. By modifying a commonly available torch you can forget about buying batteries for years and have a torch that *always* works when you pick it up. You'll also be helping to preserve the environment.

by MARK HURRY and DINO IUS

This project is the 6-volt Lantern Torch equivalent of the 'Swiss Army' knife, and while it does not come equipped with a corkscrew, it does feature some remarkable high capacity *sealed lead-acid batteries* – as distinct from 'gel' cells – with a standby float life of 8 to 10 years. It also features a novel on-board charger, a low battery warning indicator and true 6 volt operation.

The project can be charged using a plugpack, solar cells, a car cigarette lighter or any other 12 – 16 volt DC source. A socket is also provided to allow the internal 6V battery to be used as a portable power supply for radios, cassette players, CD players and so on.

In fact the project can also be used as the basis of many heavy duty portable power supplies of the type needed for mobile cellular phones, two-way radios and video cameras. It would also be suitable for powering burglar alarms. With two of these battery packs in series, there's even the possibility of being able to start a car engine, if you're stranded in the bush with a flat car battery!



Special cells

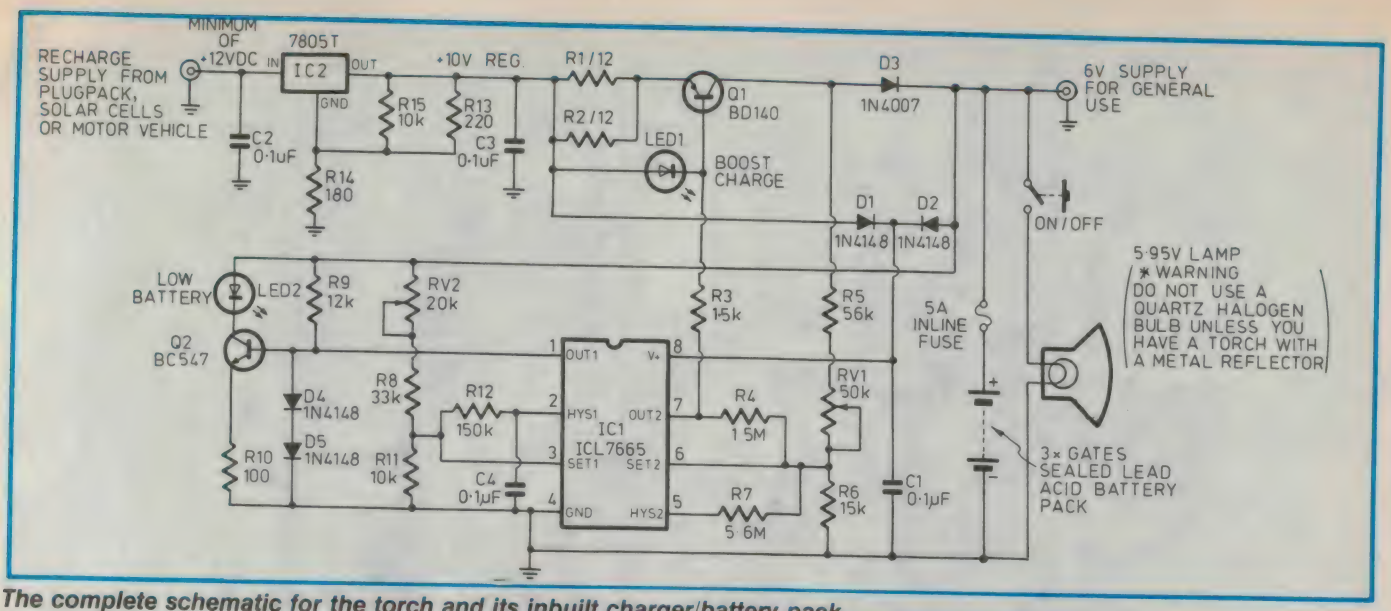
The heart of this project lies in the special rechargeable secondary cells it uses. These are Gates sealed lead-acid cells, which are quite different from the common 'gel' type.

The construction of a Gates cell is shown in Fig.1. Both positive and negative plates begin with a very low alloy metallic lead sheet, which is formed to yield strips with a grid-like structure. The grid cells are filled with the active materials. Plates and separator are interleaved and wound into a rugged, compact, cylindrical roll.

These thin plates, combined with the spiral wound construction, keep most of the active materials near the working surface of the electrodes. This provides for very low internal impedance, high energy density, low polarisation losses and efficient recombination. This is where the oxygen gas generated at the positive plate, on float charging, is reduced again at the negative plate, and is directly responsible for the cells' 8 to 10 year continuous float charge life.

The electrolyte used is an aqueous solution of sulphuric acid. The amount used is just sufficient for the chemical process. The 'starved' electrolyte construction reduces the possibility of leakage.

The inner cell container which holds the wound roll is polypropylene. The outer metal container provides mechani-



The complete schematic for the torch and its inbuilt charger/battery pack.

cal strength, and together the two combine to significantly reduce the rate of gas diffusion through the cell walls. In this way very little water is ever lost from the cell.

During normal operation, the safety vent remains closed, but if the cell is abused the vent momentarily opens to release excess pressure – preventing cell rupture. The vent then quickly reseals, allowing continued normal operation.

Similar to NiCads

The Gates sealed lead-acid cell, like NiCad types, is truly maintenance-free and can be operated in any position. However NiCads have a self-discharge rate of 25 to 30% per month, compared to 6 to 8% for the sealed lead-acid cell. NiCads are subject to thermal runaway and cell destruction if incorrectly recharged and also should not be charged in parallel – as one cell may take more current and get hot, at which point its terminal voltage actually falls. This makes it draw still more current, until it is destroyed.

The 'state of charge' of a NiCad can only be accurately determined using special techniques and calibrated laboratory equipment. NiCads also exhibit 'memory effect', where their performance varies depending upon recent usage. If a NiCad cell has been repetitively discharged to a shallow depth, any attempt to achieve a deep discharge will result in the cell delivering only the capacity of its previous discharge cycles.

If a NiCad cell is charged in the reverse polarity, which can happen during a deep discharge in a series string of cells where one cell has less capacity than the rest, it will emit hydrogen gas and eventually dry out. In standby applications NiCads are limited to trickle charging at the capacity/100 rate. However they then cannot be discharged at much more than the trickle rate, because of excessive polarisation.

In contrast, Gates sealed lead-acid cells may be recharged in parallel, suffer no memory problems and may be partially or fully recharged in reversed polarity with no harm or loss of capacity. Further advantages are that the 'state of charge' can be determined simply with a voltmeter, and that the full rated capacity is instantly available from float-charged cells.

A lead-acid cell delivers 2.0 volts in terminal voltage, compared with only 1.2V for a NiCad. Therefore to make a 6V pack you need only three Gates cells, compared with five NiCads.

Other lead-acid cells

The most familiar lead-acid battery is of course the 'flooded electrolyte' type as found in the car. These are neither convenient nor sealed for portable applications.

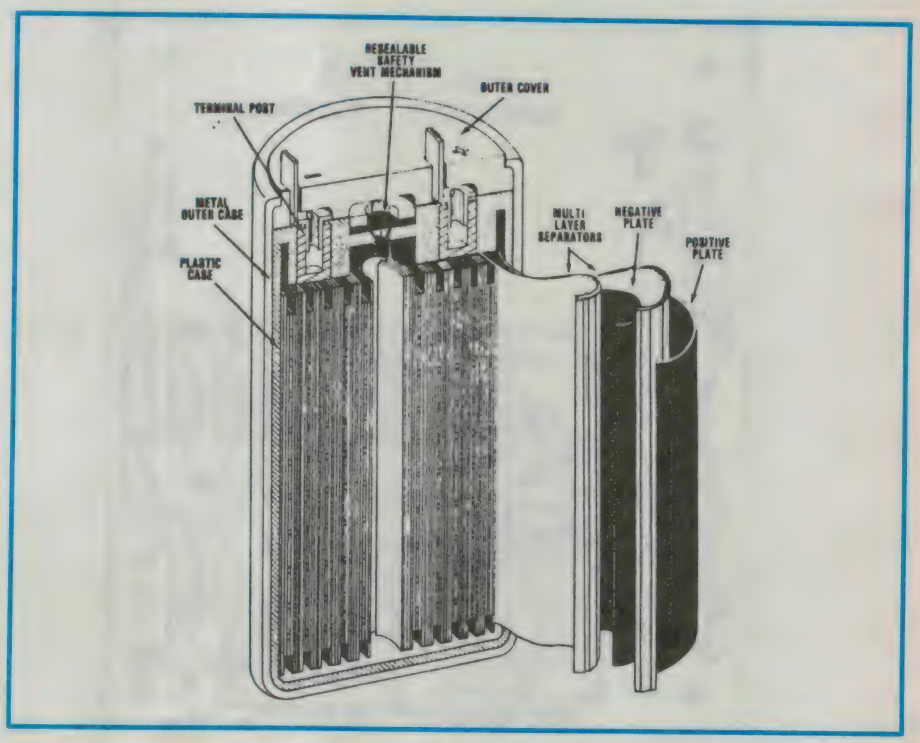
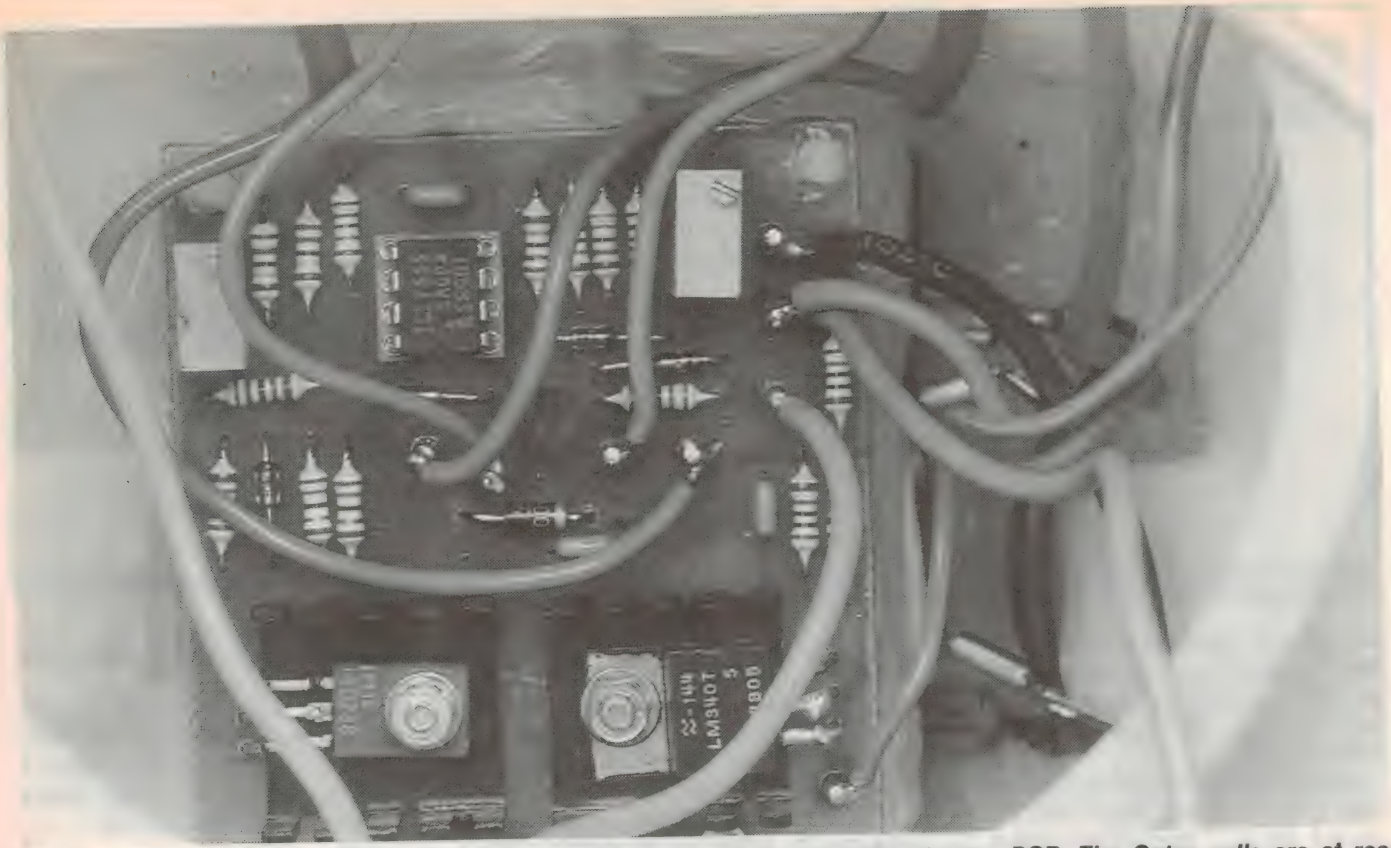


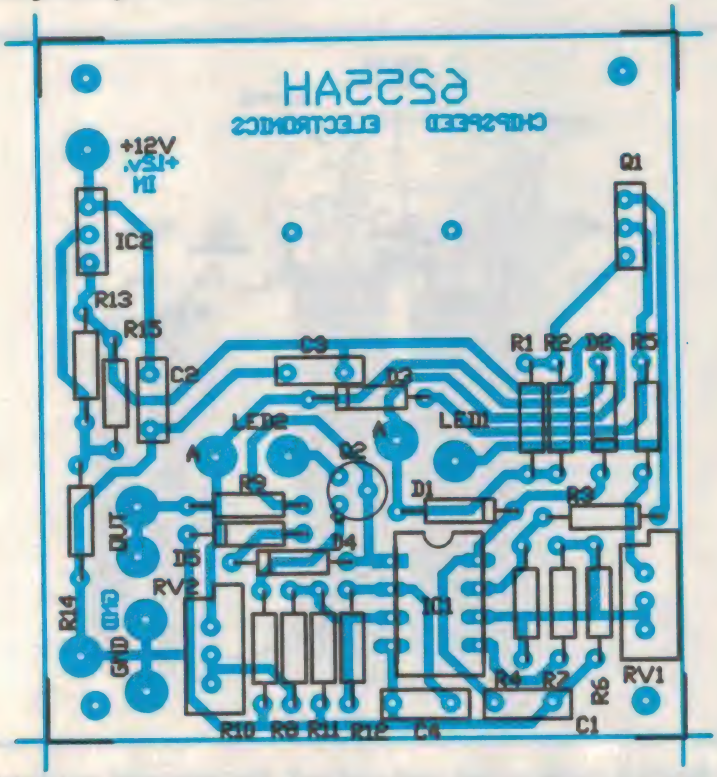
Fig.1: Inside a Gates sealed lead-acid cell. The 'wrapped' construction gives high energy density and very low internal resistance.



A look inside the torch with the reflector assembly removed, showing the charger PCB. The Gates cells are at rear right, held in place by 'neutral cure' gutter sealant.

Some lead-acid batteries use a gelled electrolyte. However these still have the disadvantage of the 'flat plate' construction, requiring stronger lead alloys – which accentuate self-discharge and gassing on overcharge. They are not designed for the higher pressures required for efficient recombination in float applications, and eventually dry out. They may also 'ooze' when overcharged upside down.

The internal impedance of gel cells is often more than twice that of the Gates cells, which severely limits their maximum discharge rate. As gel cells age they also dry out, and the Gel may 'shrink' away from the plates, reducing effective capacity.



Use this PCB overlay diagram as a guide when fitting the components.

Charging & discharging

Constant current charging is the best method of recharging Gates cells in series. This method tends to eliminate any charge imbalance and recharges all cells equally – because it is independent of the charge voltage of the cell. This is important, as cells do not have exactly matching capacity characteristics. Some cells will be exhausted before others, and consequently try to draw more current than required by the other cells when recharging.

On the other hand constant *voltage* charging is best when the cells are fully charged. With a constant voltage level set to the proper point, the Gates cells can be float charged for up to 10 years, the cells only accepting sufficient current to maintain full capacity.

The discharge voltage of a Gates sealed lead-acid battery is quite stable throughout most of the discharge time.

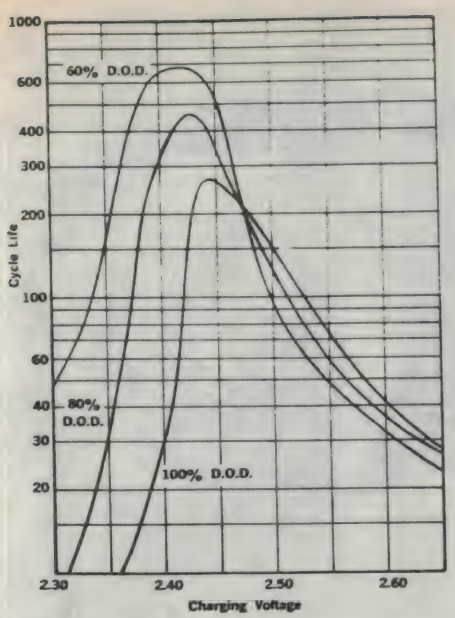


Fig.2: The effect of discharge depth on cycle life, as a function of charging voltage, at 23°C (16H charging).

The ultimate cyclic life of the battery is related to its charge and discharge rates, and there are guidelines set out in order to obtain the maximum life from the battery pack. In general terms the deeper the discharge, the fewer the number of recharge cycles – with a minimum life of around 200 cycles, for 100% discharge (Fig.2).

Clean, cheap power

Incidentally this project makes a great deal of sense both economically and environmentally, when you consider the cost of even the cheapest 6-volt primary lantern battery at about $3.50. If you obtain 200 to 2000 cycles from the Gates sealed lead-acid batteries, that represents a saving of some $700 to $7000 worth of materials that would otherwise have been mined, processed, consumed and thrown away.

A fully charged Gates battery stored at 23°C can be expected to self-discharge in three years (which is slower than a zinc-carbon primary battery sitting unused in the torch). If you store it in the refrigerator at 0°C, this time extends to nearly 20 years.

Circuit operation

A feature of this circuit is that when the battery voltage rises above a certain threshold, the charger automatically switches from constant current mode, which is the best method for fast charging initially, to constant voltage mode – which is the best method for float charging. If the voltage subsequently falls below a second threshold, the charger reverts back to constant current mode.

The circuit is shown in Fig.2, and can be better understood if it is broken up into three parts: the actual charging circuit, the high/low switchpoint sensing and the low battery warning section.

The charging circuit is made up of R1, R2, R3, LED1 and Q1, which form a constant current source of some 160mA when fully turned on by IC1. In the float mode this circuit is only partially turned on by IC1 and operates in a linear mode, giving a constant voltage output.

Resistors R5, RV1 and R6 form a divider chain to reduce the battery voltage (minus the isolation diode D3's drop of 0.7 volts) to about 1.3V, which is the nominal voltage of IC1's internal comparator reference. This point is acted upon by the hysteresis input (R7), which then sets the boost turn-on point of the charger. Resistor R4 also acts as a feedback resistor, aiding the action of R7 and limiting the linear region mode for the constant voltage function from 0 to 30mA. The actual current is determined by the batteries themselves, and normally varies between 1 and 5mA.

If the current is greater than 30mA, the charger then reverts to the full rate boost charge. This feature allows the battery pack to be left floating on the charger indefinitely. Also by limiting the linear region, it allows the batteries to be recharged to nearly full capacity at the quickest rate consistent with near-maximum cyclic life.

D1 and D2 ensure that IC1 is driven by the highest available supply, either by the battery with the charger disconnected, or by the charger when recharging the battery. This ensures that IC1 (which is a '4 diffusion layer' device) does not act as an SCR if an input pin voltage exceeds its supply voltage. It also ensures that the IC is operational at all times, allowing it to monitor the battery and provide a low level warning.

If the batteries are connected to the charger in the reverse polarity IC1 will act as an SCR and not function properly. But as all IC pins are externally current limited to less than 4mA, there is no damage done. Normal operation is restored simply by reconnecting the batteries correctly.

RV2, R8 and R11 form the battery voltage monitor divider network. R12 provides the hysteresis which sets the high level switch point. When the low battery warning LED (LED2) comes on, the cells have been nearly fully discharged and to continue for much longer may damage the batteries if they are then stored in this condition. So when this occurs, they should be recharged as soon as is practical. The high set point of 7.13V, when the low battery LED is extinguished, represents about 90% returned capacity.

Finally R9, R10, Q2, D4 and D5 form a constant current sink for LED2. This ensures a nearly constant LED brightness, from maximum battery voltage down to a nearly dead flat pack of 2.5V. The current is limited to 5mA, for minimum battery drain. This LED can be mounted in any convenient location.

Construction

Assembly of this project is not difficult, but requires care and good soldering. Its portable nature means that it could unknowingly end up rolling around in the back of a car and thus be subject to undesirable shock and vibration. Even though every torch that is modified with this charger won't be transported around in a vehicle it would be a good idea to construct it as if it were.

Incidentally, a kit of parts for this project is available from Chipspeed Electronics, of PO Box 337, Wentworthville 2145. The kit includes everything required for the charger assembly and battery pack, including the three 'D' size Gates cells – but not the items shown as 'optional' in the parts list. The price of the kit is $77.00, including packing and postage.

Start construction of the PCB by installing the 10 Vero pins in the board. These are a push fit, with a small pair of pliers. The ends of the pins that aren't knurled are pushed through the hole towards the solder side. Before soldering the pins, snip off their ends with a largish pair of diagonal cutters. This avoids applying a large shock to the soldered joints, to minimise the possibility of future dry joints.

Install each resistor flat down on the PCB and 'splay' the leads slightly on the solder side so the resistor won't fall out. Snip off one lead and solder it, then straighten the other lead before soldering it. This effectively reduces stress on the component body during and after soldering.

It's optional whether you install a socket for IC1; but if you're going to, solder it in now. Although not essential it is a good idea to insulate the 7805T regulator and BD140 transistor from their respective heatsinks. If not for any other reason, it serves to reduce the amount of 'live' metal inside the torch. The heatsinks used were obtained from

Jaycar Electronics (see parts list), but suitable U-shaped heatsinks could be made from scrap 16 gauge or similar, aluminium. Just make sure the heatsinks don't touch each other, or any adjacent components.

After bending the leads of the 7805T and the BD140 to suit the holes in the PCB, mount them on their heatsinks, snip off their leads ready for soldering and then finally solder them in.

Mount the four diodes and the two capacitors using the same method as for the resistors, being careful to minimise stress on the components. Make sure the diodes are the correct way around. The two upright multi-turn trimpots can now be soldered in, making sure each one is installed in its correct location.

Insert the 7665 into its socket or solder it into the PCB. When handling and soldering the 7665, take care as it is a CMOS device.

The PCB assembly is completed by press fitting four plastic standoffs into their holes on the PCB. These are used so that a keying action is obtained when the PCB is mounted in place on top of the neutral cure 'silicone gutter sealant', used to hold the batteries and PCB in place in the torch case.

Sealing lead-acid batteries in the case with neutral cure sealant? When your gasps of disbelief have subsided, remember that the Gates sealed lead-acid cells will have a life in the vicinity of 8 years or more.

If you can't bring yourself to committing such a permanent act on the torch, there are two other options. One is to pot the batteries in the torch with the sealant, and connect the charger (external in a jiffy box) via a socket on the torch. The other is to similarly have the charger external, but instead of holding the batteries in with sealant you roll up some bubble plastic and jam it in the torch so the batteries can't move. This last method is quite successful and is still in use on our first prototype.

If you make up this small adaptor box, with a power connector linked to a BNC socket, a standard BNC/BNC cable can be used for charging via a plug pack supply.

The prototype torch, showing the indicator LEDs and BNC connectors. The latter are fitted with captive caps, for weatherproofing.

The instructions on how to fit the batteries and charger into the torch are for a recent model lantern battery powered 'Dolphin' type torch. If you want to use a different torch casing it would be best to use the instructions only as a guide.

Whether you intend to use the same casing as the prototype or something else, carefully plan where you are going to drill holes to mount the BNC input/output sockets and LEDs. Make sure you can get tools on the socket nuts to tighten them up. A 1/2" AF tube spanner would be ideal for this.

By the way BNC sockets were selected for the input/output connectors because they can be waterproofed with a cap and chain assembly.

Before installing the BNC's, pre-tin the earth lugs so a minimum of heat is transferred to the plastic case when soldering the connecting wires. Also check that they don't protrude inside the case and make contact with anything they shouldn't.

It is worth considering your knuckles when selecting the locations for the BNC sockets. The LEDs, as seen in the photograph of the torch would be better mounted *above* the BNC sockets, because of better visibility and less likelihood of fouling with the internal clip-in switch assembly. The output socket is optional, so if you don't think you'll need a 2.5Ah/6V portable supply, then omit it. When mounting the input/output sockets and LEDs use a smear of sealant to keep the torch waterproof.

Lay two of the batteries on their sides in the bottom of the torch case, with the torch standing on its end, and then place the third one on top of them. Rotate the batteries so that minimum bending of the battery connecting tabs is required when the push-on terminals and wires are installed. Note the orientation of each battery, and then remove them from the case.

Orientate the batteries in exactly the same way outside of the case and wrap enough insulation tape around them (about two turns) to hold them in place. Crimp or solder two links using 4.8mm push-on terminals and 24/0.2mm wire. Make sure you use enough wire, otherwise undue tension could be applied to the terminal/wire junction when the batteries are fitted into the case. It's alright to use 32/0.2mm wire if you have it, but no larger.

Connect the links to the three batteries, so as to connect them in series. Always be careful not to short the terminals on these batteries, because they can deliver a rather large short circuit current.

Using a red wire from one end of the fuseholder (for the positive terminal) and a piece of black wire (for the negative terminal), crimp or solder 4.8mm push-on terminals. Make these two wires long enough to extend out of the torch case when the batteries are installed in position. Wrap a small piece of insulation tape around the untermi-

nated ends of the wires (to prevent short circuits during construction) and instal the wires on their respective battery terminals.

Now do a trial run of fitting the batteries, by carefully lowering them into the case. The object of this is to gently bend any of the terminals and wires to allow them to slip into the bottom of the case. After this is done remove the batteries. Before permanently installing everything inside the torch case we have to set up and test the circuit.

Testing & setup

A neat way of connecting the BNC input socket of the torch to the usual 2.5mm female DC connector of a plugpack supply is to mount a BNC socket and a 2.5mm male DC chassis connector in one of the very small jiffy boxes and wire them together (see picture). This allows you to use a standard BNC-BNC connector lead to the torch itself. But if you elect to do this, check that the centre pin of the BNC socket is positive after the plug pack is connected and turned on briefly, before turning off and connecting the lead to the torch.

For the following testing procedures, temporarily solder two wires from the torch's DC male connector. Then, after checking for correct polarity, solder them to the PCB. Also temporarily solder two LEDs onto the respective pins of the PCB and connect up the rest of the circuit as shown on the circuit diagram. The last thing you should do is instal a 5-amp fuse in the fuseholder.

An SCR latching action inside the 7665 will probably switch on the 'low battery' LED as soon as the battery is connected to the circuit. Ignore this and switch on the 12V plugpack supply. The 'low battery' LED should go out and the 'charge' LED should come on. If this happens, then the battery is charging normally.

If the 'low battery' LED remains on, either the battery is very discharged or RV2 is set a long way from its ideal point.

Connect a voltmeter across the batteries – a digital voltmeter is desirable, but a well calibrated analog instrument will be suitable. Screw the adjuster on RV1 most of its way up (anticlockwise) and monitor the voltage until it reaches 7.48V. Slowly adjust RV1 by turning the adjusting screw clockwise until the 'charge' LED extinguishes. This is the float charge mode; the circuit will switch back to boost charge when the voltage drops to approximately 7.02V.

Initially, the charger will be in the boost mode more than the float mode, but gradually the boost mode time will become shorter until the batteries are fully charged – at which point the charger is permanently in the float mode with the batteries stabilised in the region of 7.02 volts.

When the charger is alternating between boost and float modes, monitor the upper and lower voltages and make any fine adjustments to RV1 to keep it between the above mentioned limits. The 7665 is internally temperature compensated, so there is virtually no drift in output voltage due to temperature changes.

Once the voltage has stabilised, switch off the plugpack supply, screw RV2 through most of its travel clockwise and clip a 22-ohm 5W resistor across the batteries. When the voltage reaches 5.80V, slowly adjust RV2 anti-clockwise until the 'low battery' LED comes on. Disconnect the 22-ohm resistor and turn on the plugpack supply. When the battery voltage reaches approximately 7.10 volts (batteries about 90% charged) the low battery LED will go out.

Note that once the low battery LED is allowed to latch on, any other adjustment of RV2 is meaningless until the 7665 switches the LED off after the battery volts have risen. This is because of the built-in hysteresis of the circuit, which makes it ignore any low point input until the upper switching point is reached.

Repeat the above procedure two or three times more, with a 8.2-ohm 5W resistor instead of the 22-ohm resistor, to give the circuit a thorough testing and to make sure RV1 and RV2 are set correctly. By the way the above charge and discharge cycles take many hours, so carry out the setting-up procedure when you have plenty of time available.

When you are convinced that the charge circuit works and it is ready to install in the torch case, disconnect the LEDs and temporary wiring.

PARTS LIST

1 PC board, coded 6255AH
2 Mini heatsinks, Jaycar HH-8502
1 5.95V torch globe
1 3AG 5A cartridge fuse
1 3AG in-line automotive fuseholder
3 Gates sealed lead-acid 'D' cells
6 4.8mm quick-connect terminals
4 Nylon PCB standoffs, to suit 4mm hole
10 Vero PCB pins
2 6BA screws/nuts/washer sets for heatsinks

Semiconductors

IC1 7665CPA IC
IC2 7805 regulator IC
Q1 BD140 or BD238 transistor
Q2 BC547 transistor
D1,2,4,5 1N4148 diode
D3 1N4007 diode
LED1 5mm LED (red) with mounting bezel
LED2 5mm LED (red, amber or green) with bezel

Resistors

All 1/4W metal film:
R1,2 12 ohms
R3 1.5k
R4 1.5M
R5 56k
R6 15k
R7 5.6M
R8 33k
R9 12k
R10 100 ohms
R11 15 10k
R12 150k
R13 220 ohms
R14 180 ohms
RV1 50k top adjusting trimpot
RV2 20k top adjusting trimpot

Capacitors

C1-4 0.1uF monolithic ceramic

Optional:

1 'Dolphin' torch
1 Cartridge of 'neutral cure' gutter sealant (see text)
2 BNC panel-mount sockets, single hole type with earth lugs
2 BNC cap and chain assemblies
2 4BA screws/nuts/washers to mount BNC cap chains
1 12V DC plugpack supply
1 8-pin DIL IC socket
1 Small jiffy box with panel mount BNC socket and panel-mount 2.5mm DC connector (male)
1 BNC to BNC lead.

Note: A kit of parts for this project, including all parts except those listed above as 'optional', is available from:

Chipspeed Electronics,
PO Box 337, Wentworthville 2145.

The kit is priced at $77.00 including packing and postage. Send SAE for data on prices for individual items.

Watertight Hi-Light

Final assembly

You will need to buy a 310gm cartridge of (clear) *neutral cure* gutter sealant, from a hardware store. Make sure it comes with a nozzle. A ratchet dispenser gun as used with these cartridges will also be needed.

NOTE: Not all 'neutral cure' gutter sealants are suitable – some can cause corrosion of the PCB. Please contact Chipspeed Electronics for advice on the correct type to use.

Now comes the task where a bit of artistic flair can be exhibited. Apply an even layer (case on end) as possible of sealant, about 5mm, in the bottom of the torch case. Don't make it too deep, because it is very important not to cover up the connecting tabs of the batteries.

In case of an internal fault condition or sustained short circuit, there is a vent under the top cover of the batteries which releases excessive internal gas buildup. The possibility of this actually happening is very remote, but for obvious safety reasons don't cover both connecting tab areas of each battery as gasses escape via the gaps between the connecting tabs and the top cover.

After disconnecting the batteries from the charger, with the fuseholder lead and black flying lead re-taped and still plugged into the batteries, orientate the batteries as trialled before and lower them into the torch case, pushing them into the sealant until they reach the bottom of the case. Using the cartridge gun, squirt sealer into the nooks and crannies around the batteries and finish by creating a flat area of sealant above the batteries – slightly larger than the PCB, and a maximum of 5mm thick. Remember not to put any sealant down the connecting tab side of the batteries.

Insert the PCB onto the sealant, making sure that the standoffs anchor into the sealant. The tabs on the standoffs are to ensure that they 'key' into the sealant. The PCB is installed so that the heatsinks are *away* from the handle of the torch.

Leave the torch in its up-ended position for about two days, to allow the majority of the sealant to cure. It will actually take longer than this to completely cure, but this will be sufficient time to be able to proceed with the wiring.

The wiring can be commenced by connecting the input/output sockets and the LED's. Cut the LED leads to about 5mm and push plastic spaghetti over the soldered area, to prevent the possibility of short circuits. Next solder the wires which connect common and charger output on the PCB to the metal contact areas of the original battery connector.

When cutting the wires before soldering to the clip-in switch assembly/original battery connector and second half of the fuseholder, make them long enough to comfortably extend out of the case by a few centimetres so that the other internals of the torch can be easily accessed if required in the future.

The larger U-shaped original battery contact area needs to be scraped with a file and tinned before attempting to solder a wire to it. If it has a brass rivet this is easily soldered to. The other contact also has a brass rivet which can be soldered to. Solder quickly, otherwise the plastic around the rivets can melt and a bad contact could result. If you are unsuccessful soldering onto the rivets, remove the excess solder and drill out the rivet to take a short 6BA, or similar, nut and bolt; then use a solder lug to attach the wire or wires.

The last part of the wiring is to connect the battery and fuseholder to the rest of the circuit. Cut the black (negative) battery wire to a suitable length and solder it to one of the common pins on the PCB. Connect the other end of the fuseholder to one of the charger output pins on the PCB. Install a 5A fuse in the fuseholder and slide it into the gap adjacent to the battery connecting tabs.

As you install the clip-in switch assembly into the torch case, you will probably have to push and bend some of the wires out of the way. If the switch assembly won't immediately clip in easily, remove it slightly and bend the obstructing wires out of the way.

Before screwing the reflector housing onto the torch, remove the original 4.8V lamp and replace it with the 5.95V lamp supplied in the kit of parts. The terminal voltage of the Gates cells doesn't sag on load like standard carbon/zinc primary cells, so the higher voltage lamp has to be used. The 4.8V lamps have been found to last for only about 15 minutes.

Do not use halogen or Krypton lamps unless your torch has a special reflector designed to accept these high temperature lamps. The combination of the Gates cells and the 5.95V lamp provides a consistent bright white light, which in our view makes a halogen lamp unnecessary.

All that has to be done now is to screw on the reflector housing and enjoy years of economical torch operation.

Precautions

Always remember these are Gates lead-acid cells you are dealing with. A 'D' size cell, as used in this project, can deliver upwards of 200 amps into a short circuit!

For this reason, we strongly recommend that you observe the following:

- Always remove rings, watches and bracelets which might accidently short-circuit the cells.
- Never toss one or more cells casually into a drawer, cabinet or rubbish bin.
- Never use uninsulated tools when working in the vicinity of cells.
- Never lay metal parts on top of a cell, or place the battery terminals in contact with a metal surface.
- Never place a cell in a pocket containing coins, keys or metal pens. A short-circuit may cause burns or possible fires.
- Do not puncture or incinerate a cell.

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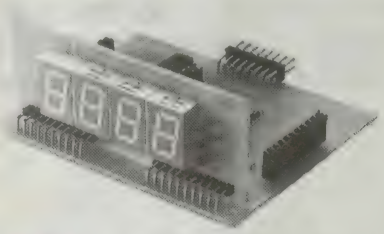

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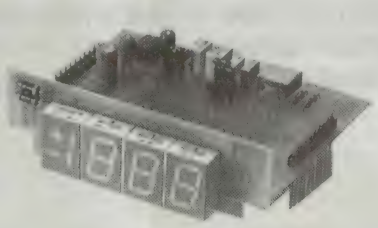

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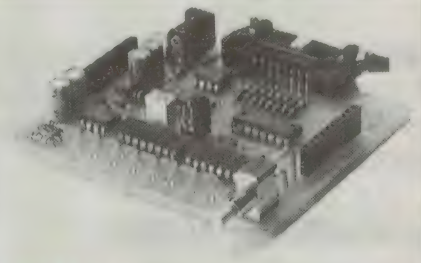

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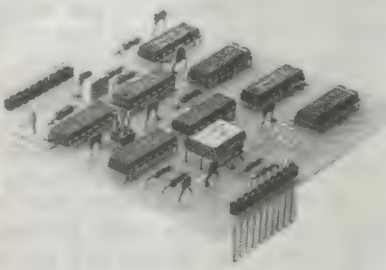

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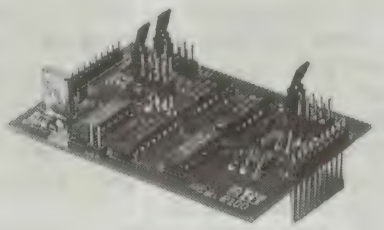

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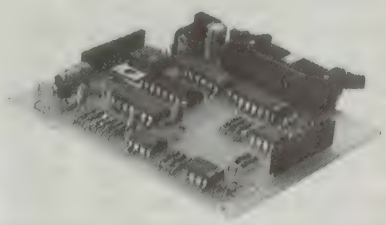

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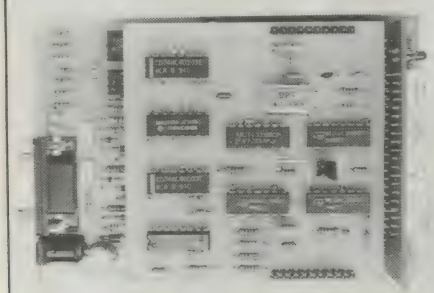
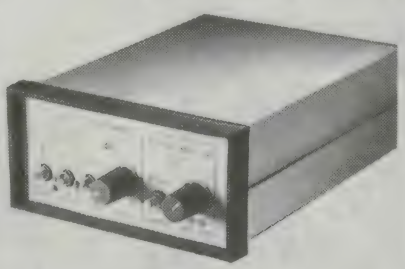
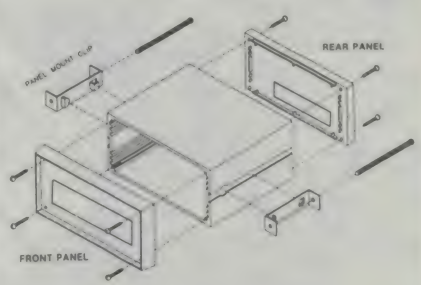


ATM26 Digital Amphometer (CAR SPEED METER) as per April EA complete W/Sensing Cables, case and connectors. Opto beam break kit ATM20 $48.50 ea- 2 needed. **$175.00**



ATM17 Digital Storage Adaptor for Oscilloscopes 200 to 200K Samp./Sec as Per Dec. '89EA .....**$185.00** (Complete W/Case)



HWK/UB70 Universal extruded Al. Panel Mtg. case w/Bezels & Filter ***FOR ALL ABOVE KITS*** **$35.50**

Construction Project:

Low cost Phone Amplifier

Here's an easy to build little amplifier for use with a magnetic phone pickup – so that a group of people can listen in to an important conversation. Complete safety is ensured by running it from an internal battery, which makes the project a good choice for the newcomer to electronics.

by ANDREW PALMER

Brring! Brring! The phone rings, and it's Aunt Betsy ringing from the other side of the world. The whole family wants a word, or at least to hear what Aunty has to say. But international calls are expensive, and Aunty can't afford to talk for long – so only Dad gets a chance to hear her voice...

Or here's another scenario. The sales manager has all of his staff in the office, when the phone rings. It's the branch manager from interstate, with a curly question from a client; unless he can get an answer fast, that big deal is off. What a pity that the company couldn't afford to get the sales manager a loudspeaking phone, so everyone would be able to hear the problem and help him formulate the best answer...

Neither of these situations need occur. One of the new 'hands free' loudspeaking phones would be one solution, of course, but they're still a little pricey – especially for the average home. And you can't *really* justify the cost, if you're only going to use it every now and again.

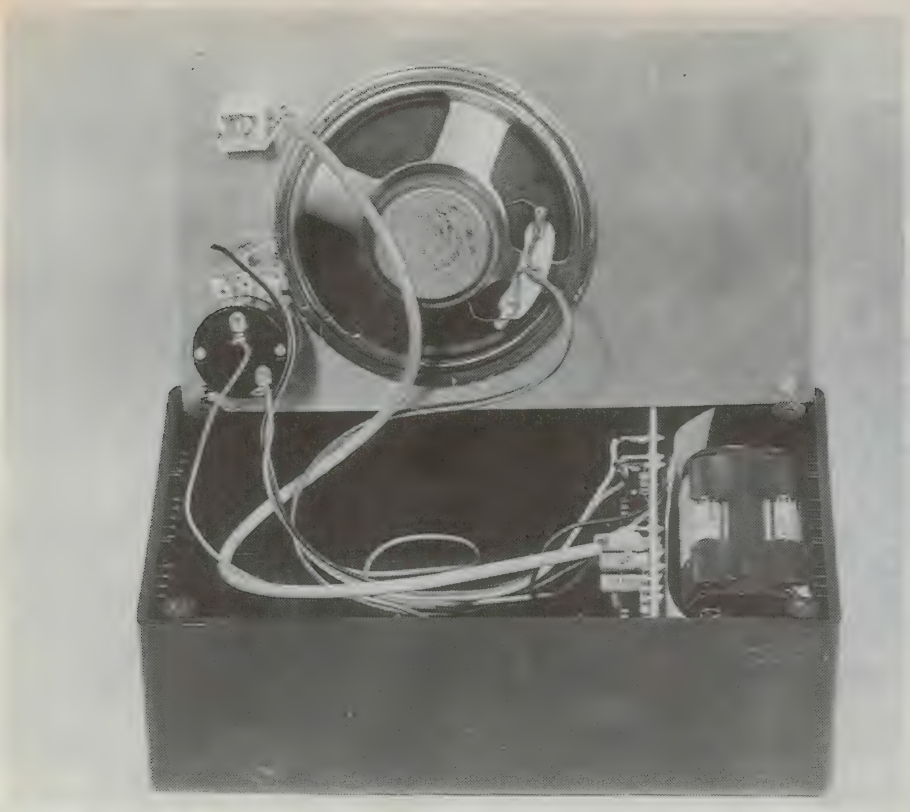
But there's a simpler solution, and it's a lot cheaper too. All you need is a little battery-operated amplifier, and one of those telephone pickup devices that uses a coil to pick up the weak magnetic field around the telephone earpiece. Just turn on the amplifier, attach the pickup to the phone's earpiece with its built-in suction cup, and suddenly everyone can listen in!

The neat little amplifier described here has been designed specifically for this use. It even includes a simple but effective electronic high-pass filter, to cut down the hum which often occurs with this kind of amplifier due to the magnetic pickup unit responding to stray 50Hz fields from power wiring, etc.

As well as doing the job effectively, this design is both low in cost and easy to build. Being powered from an inbuilt battery, it's also completely safe – making it a great project for the beginner. Since there's no electrical connection to the phone or Telecom line, you also don't need any kind of permit or licence from Telecom to use it.

Incidentally *Electronics Australia* can't take the credit for developing this handy little design. It comes from those bright people at Dick Smith Electronics. This means that things like the PCB pattern and front panel artwork are copyright to DSE, and can't be reproduced commercially – so you'll only be able to buy kits for the project from DSE stores and dealers.

Of course if you're a dedicated do-it-



Inside the case. The PCB mounts vertically as shown in a pair of slots, so that it doubles as a partition to restrain the battery pack. A small piece of plastic or cardboard prevents the batteries from shorting the PCB tracks.

yourselfer, you can still make your own PCB by copying the layout. You'll get more experience this way, although it'll take rather longer and need rather more work. Nowadays many people prefer to simply buy a complete kit, and put it together quickly with minimum hassle. The choice is yours.

Circuit description

As you can see from the circuit schematic, the telephone amplifier consists of a preamplifier, a high-pass filter stage, and finally a power amplifier to drive its internal speaker. This is all done with a pair of low cost and readily available ICs.

Incidentally the kind of magnetic pickup device used with this amplifier cannot discriminate between the wanted signal from the telephone earpiece and ambient magnetic fields. In modern buildings the ambient field is normally dominated by radiation from the mains power wiring, producing 50Hz hum with associated harmonics, extending at least up to the 5th harmonic at 250Hz.

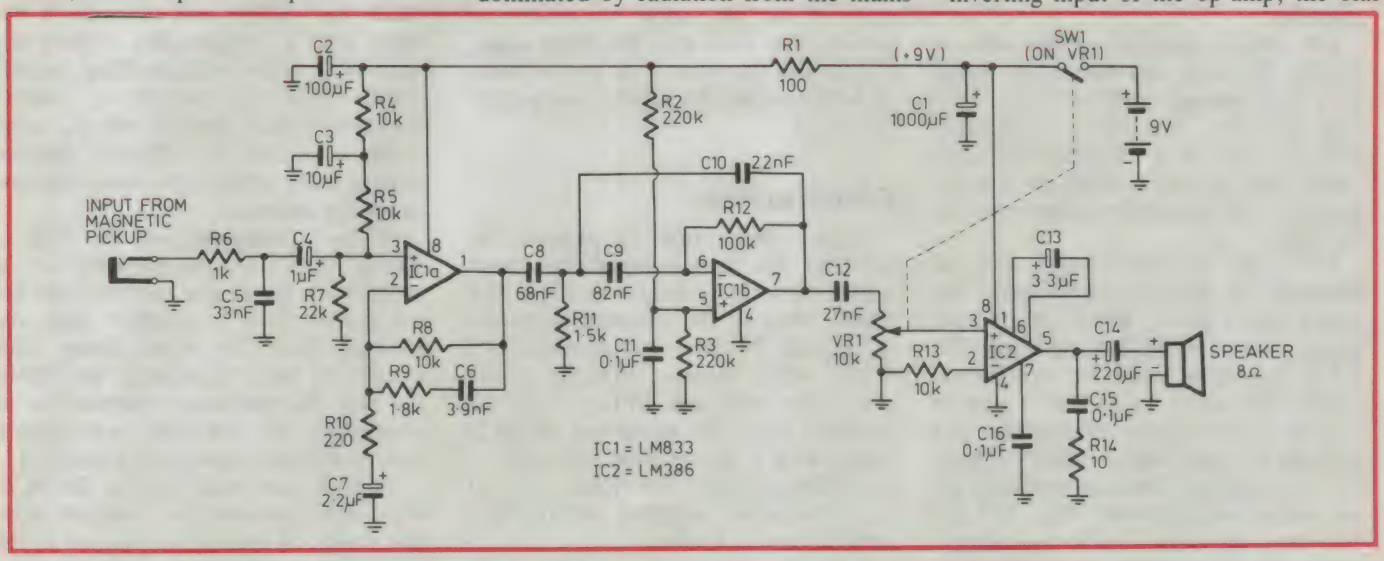
In fact, in some situations the wanted signal can be well and truly buried in mains-related noise. Therefore, to be effective, any amplifier for use with these pickups should provide significant rejection to hum-related components – without appreciably compromising voice frequency signals. The designer of the current amplifier has gone to some trouble to achieve this.

The incoming signal from the pickup first passes through a preamplifier stage made up from one half of an LM833 dual, low-noise op-amp (IC1a). R6 and C5, at the input of the circuit, initially limit the signal bandwidth to about 5kHz. C6 and R8 in the feedback network provide further high-frequency roll-off, above 4kHz, while R10 and C7 act to roll-off low end gain below 300Hz.

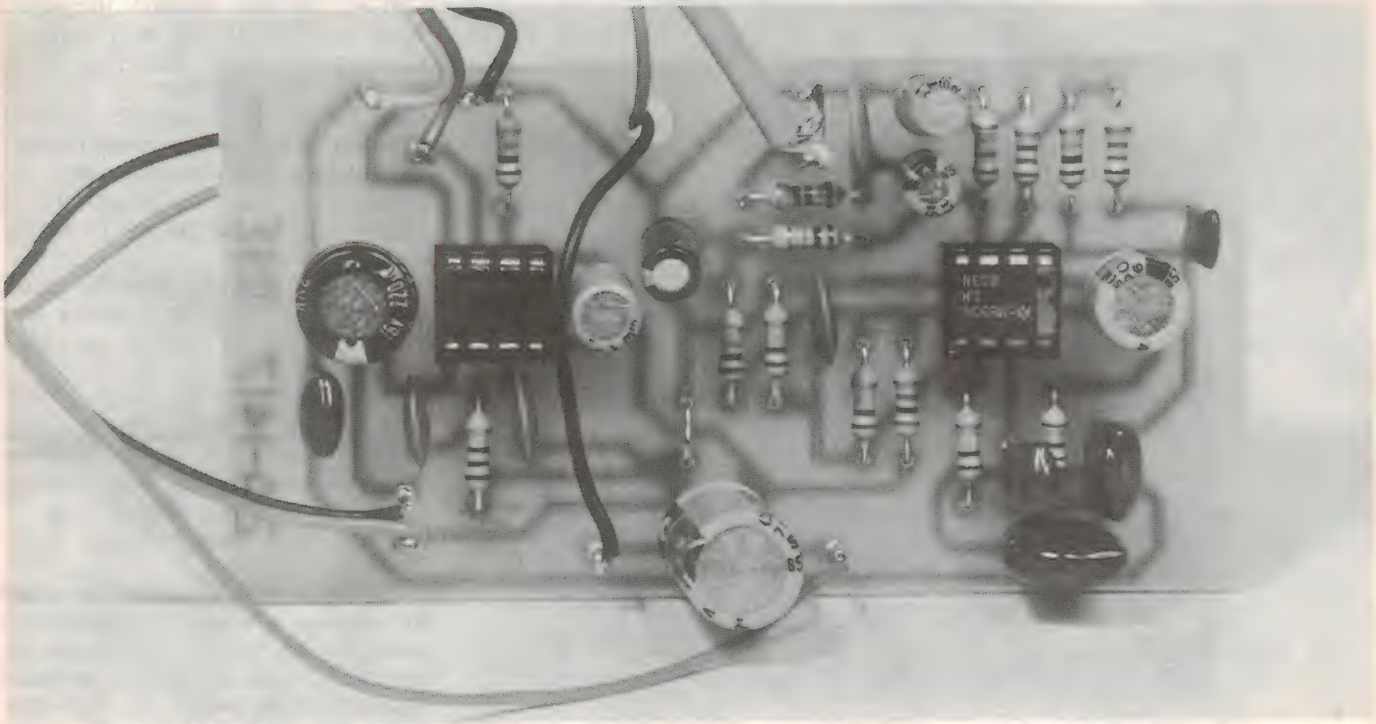
The first stage is biased at near to half the supply rail voltage by a divider consisting of R4, R5 and R7. Bypass capacitors C2 and C3 prevent unwanted signals from the supply rail from interfering with the input signal. The nominal gain of the preamplifier is about 45.

After preamplification, the signal passes to the second stage, a third-order high pass filter which uses the other half of the LM833 (IC1b). This filter stage, along with response limiting networks in other stages, acts to significantly reduce the amplification of signals below 300Hz.

The filter also provides a moderate amount of gain, about three, to the wanted signal. This stage is also biased near to the mid point of the supply rail. Because no signal is applied to the non-inverting input of the op-amp, the bias



As you can see from the schematic, the amplifier is very straightforward and uses only two IC's.



This close-up view of the assembled PCB shows where everything goes. As usual, watch the orientation of polarised components like the ICs and electrolytic capacitors. Note the 3mm hole near the centre of the top of the board, used to carry the power leads through into the 'battery compartment'.

circuit, comprising R2 and R3, and filtered by C11, is somewhat simpler than that used in the first stage.

Following on from the filter is the volume control and power amplifier. The signal is coupled to the volume control via C12, a 27nF capacitor. This capacitor removes the DC component present on the output of the filter stage, and also, in conjunction with VR1, further limits the overall response at low frequencies.

The power amplifier stage uses an LM386 IC (IC2) and boosts the signal to a high enough level to drive the 8 ohm speaker. This IC is particularly easy to use, as it is generally quite 'tame' (stable) and requires no bias circuitry or DC decoupling components at its inputs.

The gain of the LM386 can be changed by placing components between pins 1 and 8, which tap into the device's internal feedback network. The 3.3uF capacitor used in this circuit causes the device to exhibit a gain of around 200 at higher frequencies, but reduces the gain below 300Hz. Capacitor C16 provides filtering/bypassing for an internal bias network, while C15 and R14 keep the device stable by compensating for the inductance of the loudspeaker – thus ensuring that the load is primarily resistive at high frequencies. Finally, C14 removes the DC component from the amplifier's output and provides further low-frequency rejection.

Being a class B amplifier, the LM386 draws varying amounts of current in proportion to the level of its output signal. Because the battery supply does have some finite impedance, this varying current drain impresses unwanted noise on the the supply rail which can find its way back into the input stage. C1, R1 and the input stage bias network all act to reduce this effect to an acceptable level.

Construction

As you can see from the pictures, the amplifier fits in a compact mid-range plastic 'zippy' box, measuring 158 x 95 x 50mm. Most of the components mount on a small PC board, measuring 88 x 45mm, which mounts vertically in the case near one end (fitting into the moulded slots). By protecting the PCB tracks with a similar-sized rectangle of insulating material, this allows it to act as a restraining partition for the 6 x AA-cell battery holder.

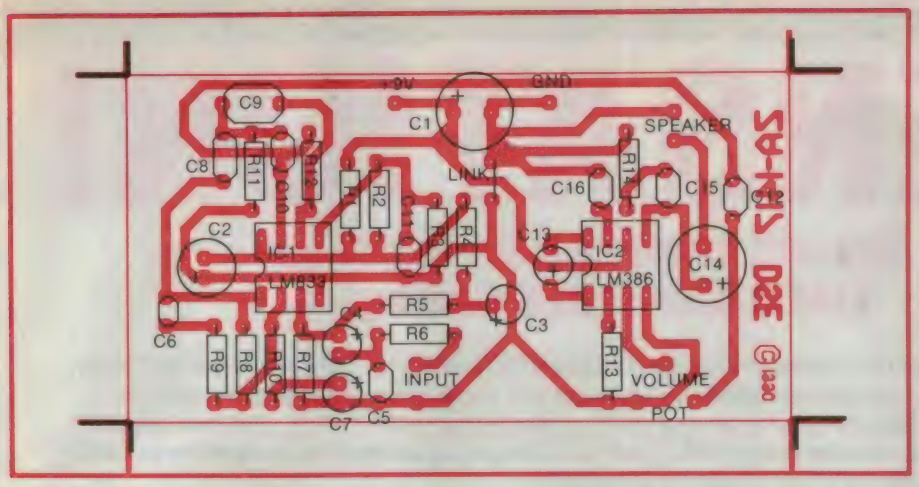
The only components mounted on the case's metal front panel are the 3.5mm input jack, the volume control potentiometer-on/off switch and the speaker.

Construction is very straightforward, but there are a few points that should be noted. Because the speaker has to be glued to the front panel it is a good idea to assemble the socket, volume switchpot and speaker onto the panel first. Then you can construct the PCB while waiting for the glue to dry.

The switchpot fits in very snugly between the speaker and the wall of the zippy box. To ensure that it does not short or interfere with anything, mount it with its pot lugs pointing up towards the input socket, parallel with the edge of the zippy box lid. Affix the speaker using a small amount of contact cement or similar adhesive.

Fit the components into the PCB as shown in the accompanying diagram. As usual it's a good idea to start with the low-profile PCB connection pins and resistors first, for convenience; then mount the taller capacitors, and finally the ICs. Pay particular attention to the orientation of polarised components, such as ICs and electrolytic capacitors.

There is one small link on the PCB, which interconnects the common negative tracks. If you make this link in the shape of a small loop, it can be used for the common lead connection for test



The PCB overlay diagram. Use this in conjunction with the picture on the facing page, to help in wiring the board correctly.

equipment such as oscilloscopes and multimeters – should you ever need to use them on it, of course!

Nine PCB pins are provided to terminate wires on the board. But don't attach the wires to the PCB pins until you have done a trial physical assembly to determine their correct lengths.

The PCB fits into the 6th slot at the opposite end of the box to the potentiometer. It is placed such that the component side is towards the speaker. This gives enough room to place the battery holder between the solder side of the PCB and the wall of the box, as noted before. Don't forget that a small piece of foam rubber, cardboard or other insulating material should be placed between the PCB and the battery holder to prevent metal-cased batteries from causing short circuits.

Because there is not enough space to route the battery leads over the PCB and down to the battery holder, they pass through a 3mm hole in the PCB. Note that the negative battery lead is soldered directly to the appropriate PCB pin, while the positive lead is extended, using a length of hook-up wire so that it can reach the switch on the rear of the volume control, before returning to the PCB. The join in the positive lead should be insulated with sleeving or tape.

Use screened audio cable to connect the input socket to the PCB. All other connections are made using normal light-duty hookup wire, such as that from 'rainbow' ribbon cable.

Using the amp

To use the telephone amplifier, simply plug the magnetic pickup into the input socket, turn it on and set the volume control at about mid travel. Affix the pickup to the rear of the telephone handset near the earpiece and adjust the volume control for a convenient level during use.

Note that the amplifier should be kept as far away from the handset as possible to avoid the occurrence of acoustic feedback.

The performance of the unit is subject to a number of factors. Firstly, in very strong hum fields, even the significant filtering provided may be inadequate. By tilting or moving the phone handset slightly, it is often possible to find 'nulls' in the field.

Secondly, the strength of the field emitted by the phone earpiece may be too low, or even non-existent. This was not found to be a problem with the prototype when tested with quite a few common phones, but there may be phones around with shielded magnetic earpieces, or even ceramic transducers.

Finally, the field around the earpiece is made up of signals from both ends of the telephone conversation. With some telephones, the level of the local party's voice can be higher than that of the distant party. This is related to a characteristic of the telephone known as *sidetone balance*. With most telephones manufactured to meet modern Australian standards, this should not be a significant problem.

When compared with similar commercially-available products, this design was found to offer superior performance.

A final word of warning. This device has not been designed for, nor is it suitable for picking up telephone signals except at the earpiece at one end of a telephone conversation. Apart from being technically impractical to try and intercept magnetic signals elsewhere in the telephone system wiring, in most cases it would also be quite illegal to do so.

PARTS LIST

1 PC board 87 x 46mm, code ZA-1417
1 75mm speaker, 8 ohms
1 Zippy box, 158 x 95 x 50mm (Cat. H-2851)
1 Punched/screened panel, to suit
1 Magnetic phone pickup (Cat.F-2705)

Resistors

All 1/4 watt:
R1 100 ohms
R2,3 220k
R4,5,8,13 10k
R6 1k
R7 22k
R9 1.8k
R10 220 ohms
R11 1.5k
R12 100k
R14 10 ohms
VR1 10k log pot with SPST switch

Capacitors

C1 1000uF 10VW electrolytic
C2 100uF 10VW electrolytic
C3 10uF 10VW electrolytic
C4 1uF 6VW electrolytic
C5 33nF ceramic
C6 3.9nF metallised polyester
C7 2.2uF 6VW electrolytic
C8 68nF metallised polyester
C9 82nF metallised polyester
C10 22nF metallised polyester
C11,15,16 0.1uF ceramic
C12 27nF metallised polyester
C13 3.3uF 10VW electrolytic
C14 220uF 10VW electrolytic
(Voltage ratings shown are minimum only)

Semiconductors

IC1 LM833 dual op-amp
IC2 LM386 audio amp

Miscellaneous

Battery holder for six AA cells; battery snap lead to suit; 6 x AA cells; 3.5mm miniature phone jack (mono); control knob for volume pot; 9 x PCB pins; hookup wire, shielded wire, solder etc.

Note: Complete kits for this project are available from Dick Smith Electronics stores and dealers, under the catalog number K-3104. Quoted price of the kit is $39.95. Copyright for the PCB and front panel artwork are owned by Dick Smith Electronics.

VIATEL SENSATION!

You will never be able to get into VIATEL this cheap ever again.

Jaycar have jumped on the bandwagon and have purchased DTX Australia Ltd 'Directronics' brand Videotex (VIATEL) terminals. These terminals enable you to connect your phone (some models even have phones supplied!), TV or RGB colour monitor to set up a VIATEL system in your home of office! Just think, you can access all of that fantastic information on VIATEL without having to pay a fortune for an expensive terminal. You will still need to pay the VIATEL service fee of course!!

Each videotex terminal contains a fully Telecom approved modem and all electronics to decode VIATEL signals and display them on your TV or RGB monitor. We have roughly the same quantities of 4 fairly similar models.

Model #1

(the cheapest) - features full console, numeric keypad (for entering into and operating the Videotex system), RF out (to your TV) but no phone. You can plug any phone into the socket provided of course, The phone is only used to access the Videotex number anyway (some phones can be used as key pads however). This machine is all you really need.

Note: this a picture of Model #2

Cat. YV-7075 **$29.95** **That's right under $30 - HURRY, HURRY, HURRY!! Worth around $250 less than a few years ago.**

Model #2 - identical to above but with a dedicated phone which can be used as a keypad.

Cat. YV-7076 **$34.95**

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This is one of the greatest bargains we have ever seen!!

Model #3 - as per model #1 but with RF and RGB video output (for better quality colour on a suitable RGB colour monitor).

Cat. YV-7077 **$34.95**

Model #4 - as per model #3 but with a phone as well.

Cat. YV-7078 ~~**$39.95**~~ SOLD OUT

SAVE

NOTE! All models are brand new in cartons with instructions. They are worth far more than this for the parts alone. They contain valuable Philips SAA5020 and 5050 chips. Because we are selling these at such a ridiculously low cost warranty is only one month from receipt. If you are worried about this buy a model #1 as a spare!

Info on VIATEL

There are two available entries into VIATEL. They are 'Discovery 40' or 'Discovery 80' depending on the level of service you require. You only need Discovery 40 with this special offer. There is a $60 joining fee and a $15 per month subscription plus Access Charge. Once you subscribe to the service you will get a pin number which will access you into the system.

For more information call 'Discovery' (Telecom trademark) on 008 033 342

Australia's Cheapest Telephone Answering Machine

The public aren't ready for this one yet!

This product was launched on the Australian market last year. It was state-of-the-art, reliable and low cost. It was a flop.
Why? Because market feedback indicated that people did not like the 'sound' of the outgoing message. This sound was, in fact, an electronic reproduction generated from a computer chip, not quite as ' warm' as an outgoing tape message.

Importers dilemma: The importer knew they had a good product but did not know how to sell it to an unsophisticated public. They called Jaycar.

Benefit from your sophisticated knowledge.
As time goes by the public will get used to computer generated voice messages. Most overseas 'operators' (especially in the USA) are computer voices - as many of you would know.
In the meantime, Jaycar bought the stock at a bargain basement price, and now we are offering it to you at a crazy price!
But first, you must be happy with the product at any price.
Quite frankly, we think that there is nothing wrong with the reproduction sound of this machine. (We really cannot understand why it 'frightens' the public, but that's what they tell us.) We have tested the machine out and all the guys here have no problem with the sound.

Extended Satisfaction Guarantee. Prove to yourself that it's OK though. Buy one of these machines and try it for 14 days (21 days for mail order). If you are not completely satisfied with this product for any reason, send it back in original condition and we will refund your money in full (less post & packing costs). We can't be any more genuine than that!
Superior features: Most of the sophisticated machines coming out today are single tape units. The public's perception lags behind this fact. This machine has other great features too:]

- **Advanced VOX system that stops recording when incoming caller hangs up**
- **Flashing LED that indicates number of messages that have been left**
- **Answers to 2 or 4 rings**
- **Memo record facility**
- **Message save option**
- **Battery backup to retain your outgoing message (battery not supplied)**
- **AUSTEL (Telecom) permit A89/16A/0057**
- **12 month - yes! - 12 month warranty**

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Quantities limited! Grab one now!
Cat. YT-7010
ONLY $89.95

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2 way kit
30 watts RMS
full kit only $369
Cat. CS-2450/52

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2 way kit
50 watts RMS
full kit only $449
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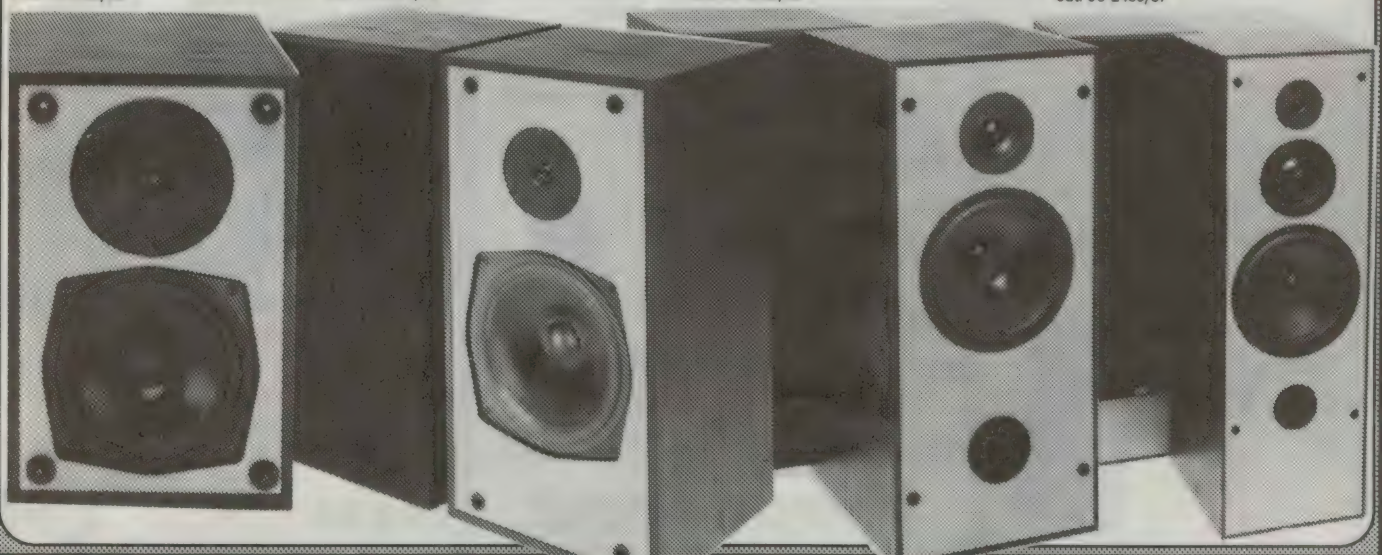
full kit only $699
Cat. CS-2460/62

VIFA SA-130
3 way kit
90 watts RMS
full kit only $999
Cat. CS-2465/67



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***70% brighter than normal torches.**

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Supplied with spare globe.

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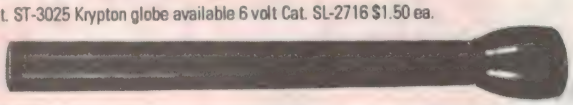

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Make a purchase from any Jaycar store on Saturdays during November and receive absolutely "FREE" a sample of "WD-40".

Offer valid for this month only.

Waterproof Box bargain

The box is made by Lume in Italy. It's waterproof/hoseproof, grey ABS with clear lid. The lid actually has a rubber gasket to ensure a watertight seal.

Size 150(L) x 110(W) x 70(H)mm. This type of box is in other catalogues for $70.

Normally $29.95

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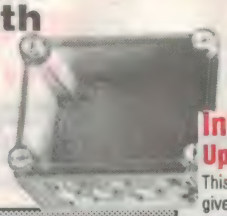
Cat. HB-6250



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Supplied with Gold plated 3.5mm stereo plug and comes with a handy carry case.

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Cat. AA-2015

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At a touch of the button on the wall plate you can dim your light and the light will stay dimmed at whatever level you lift your finger off. This function is repeated on the remote control. Wall unit colour - white with fawn panel. Two year warranty if installed by licensed electrician.

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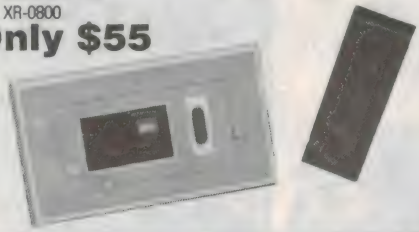
Only $55



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With built in speaker protection

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TES 2360 DMM 3.75 digit

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- temperature
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- logic

See page 5 of 1990 catalogue for full details.

All this and more for only $179

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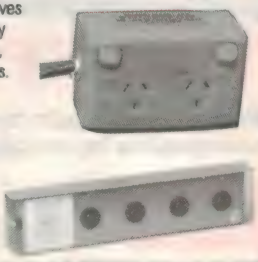

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Quality Dynamic CD Stereo Headphones

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Supplied with 1 x gold plate 3.5mm socket to 6.5mm plug adaptor.

Great value

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Construction Project:

Memory dialler for your phone

Phones with memories are not new, but most require two key presses to dial a number from the memory. This easy to build project can store up to nine 18-digit phone numbers, and three of these can be wired for single key recall – great for busy people or the disabled. Last number redial, tone and pulse dialling are all supported as well. It's cheap and very simple to install.

by JEFF MONEGAL

Like many projects, this one was developed to fulfill a need. The aim was to allow a disabled relative to be able to phone a particular number, simply by pressing a large button. Most memory phones require at least two keys to be pressed, and as these are generally rather small, those with poor sight or some physical disability often have difficulty even finding the keys, let alone pressing them.

During development, it was decided to incorporate single button dialling for up to three numbers, while retaining the conventional two-key-press dialling for all nine numbers.

The IC used in the project is a Motorola device, IC type MC145412. Motorola specialise in IC's for phones, and this one is relatively new. It needs two keys to be pressed to recall a number from memory, so additional circuitry has been added to give the single-key operation required. If this feature is not needed, it can be deleted without affecting the operation of the unit.

Another requirement is safety, both for the user and the Telecom network. As most constructors will be aware, any device added to the public telephone network must first be approved by Telecom. The fundamental specification is isolation between the phone lines and any power supply used to power the device. To keep things simple, it was decided to power this unit from batteries (4.5V), rather than increase the complexity (and cost) by adding the isolation transformer required if an external plug pack is used. Powering the circuit from the phone lines is also possible, but again isolation in the form of an approved capacitor is needed.

Phone home by pressing only one button, with our easy to build telephone memory dialler.

As the idling current of the circuit is around 80uA, increasing to around 200mA when dialling occurs, the batteries should last for their shelf life – unless you do a lot of dialling.

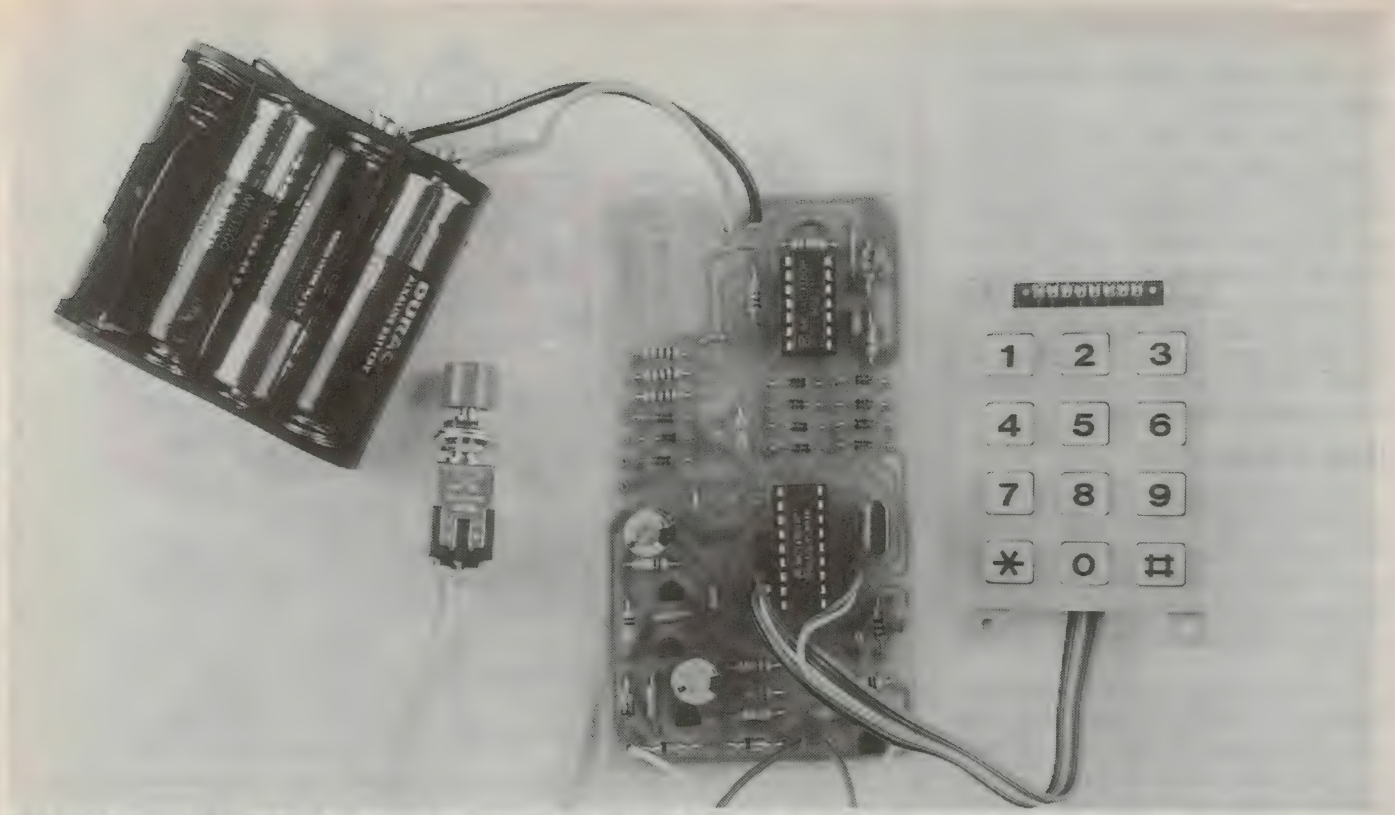
Because the unit is battery powered, it is likely the prototype will be approved by Telecom, although to date this has not been finalised. But even if it is, such approval would not cover all units – so legally, this project should not be added to the public telephone network. However, it can be used on private phone installations, and to the best of our knowledge, it complies with the regulations anyway.

What it does

As already mentioned, the project consists of two parts. The first is the standard 10-memory dialler where the recall button (* key) is pressed followed by a key that has been pre-programmed with the required phone number.

The second part adds single button dialling. Here, up to three extra buttons can be added, in parallel with keys 1, 2 and 3. The three new buttons each activate the recall action, then dial out one of three pre-programmed numbers. Because the extra buttons are conventional single pole, normally-open types, one or more could be fitted externally to the case containing the electronics, perhaps near the bed of an invalid. You could even add a UHF remote switch, whereby the relay in the receiver connects across one of the buttons. Naturally, the phone needs to be off the hook for dialling, but at least dialling the number is made much easier.

When in pulse dialling mode, an internal piezo buzzer beeps each time a



This shot shows the PCB wired for pulse dialling only, with the single button section also completed.

key (or button) is pressed; in tone dialling mode the dialling tone pairs can be heard in the phone earpiece.

Programming it

To program numbers into the memory the following sequence is required.

(1) Leave the phone *on* the hook;
(2) Enter the desired number on the key pad;
(3) Press the star (*) key;
(4) Press the number key you wish to allocate to the phone number just entered.

For example, say you want to store the number 1234567890 in memory location 1. With the phone hung up, press keys 1234567890 then press the * key, followed by key number 1. That's it! The same sequence is followed to program memory locations 2 through to 9. The 0 key is allocated to last number redial, so only nine numbers can be stored, with the tenth being the last number you dialled. When programming the unit, no dialling will take place as long as the phone is left on the hook.

Dialling out

For last number redial, pick up the phone and wait for dial tone. Then press the * key followed by the 0 key.

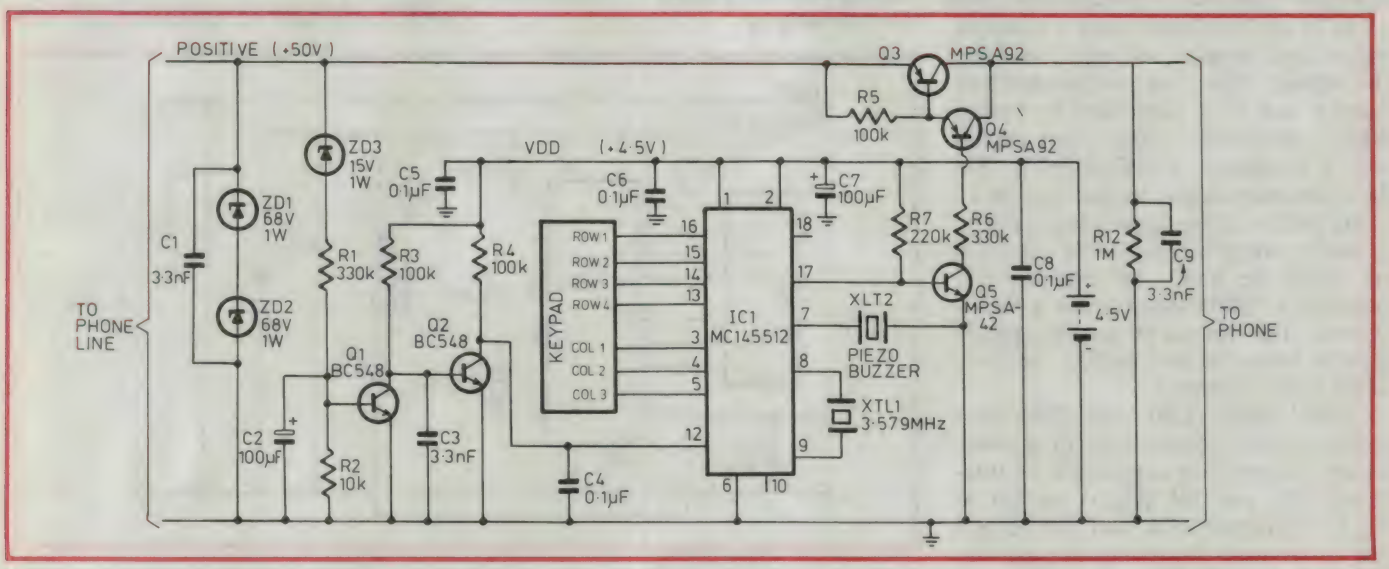


Fig.1: This circuit shows the unit configured as a pulse dialler. Q1 and Q2 detect if the phone is on- or off-hook and the pulse dialling sequence appears at pin 17 of IC1. Transistors Q3, 4 and 5 make and break the phone line during the dialling process and C2 holds Q1 on during this period.

Memory Dialler

The last number dialled will then be dialled out again.

To have the unit dial out from memory, again pick up the phone and wait for dial tone. Then press the * key, followed by the number key representing the phone number stored in that memory location. Single button dialling is even easier, as all that's required is to wait for the dial tone, then press one of the three extra buttons, depending on which of the three pre-programmed phone numbers are required.

How it works

The circuit diagram is shown in three sections and Fig.1 shows the circuit of the memory dialler section configured in pulse dialling mode. This is probably the most typical application, as the majority of exchanges still use pulse dialling.

If your exchange or PABX uses tone dialling, refer to Fig.2, which shows the relevant circuitry for this type of dialling. Note that a tone dialling exchange will also operate with pulse dialling, but a pulse dialling exchange cannot recognise tone dialling.

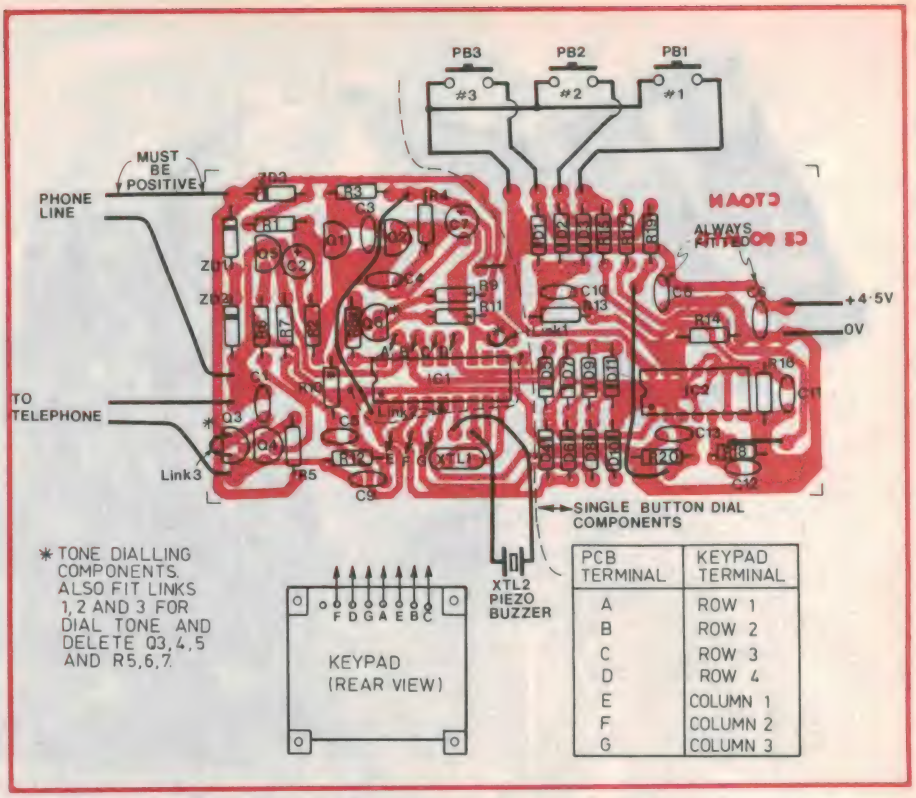
The circuit to provide single button dialling is shown in Fig.3, and this section is the same for both pulse or tone dialling. As will be seen later in this article, the PCB accommodates everything and components are fitted as required, depending on your choice of dial mode and whether the single button feature is to be included.

The heart of the circuit is IC1, described by Motorola as a *pulse/tone repertory dialler* with 10 memories. Pins 13 to 16 are row inputs from a standard matrix type keypad, and pins 3 to 5 are the column inputs. An on-chip oscillator (pins 8 and 9) is controlled by crystal XLT1, an NTSC colour burst crystal with a frequency of 3.579545MHz. Pin 18 is the tone dialling output and pin 17 is the pulse dialling output. Input pin 12 is used to identify whether the phone is on or off the hook, and output pin 7 provides a 500Hz signal when a key is pressed. This pin can be used to operate a piezo buzzer to give audible feedback when a key is pressed.

Zener diodes ZD1 and ZD2 limit spikes on the phone lines to a value within the handling capabilities of transistors Q3 and Q4 (Fig.1) or Q6 in Fig.2. Transistors Q1 and Q2 (Figs.1 and 2) are used to provide an input signal to IC1 by identifying if any phone in the installation is in use.

When all phones connected to the line are on the hook the voltage across the phone lines is about 50V. This is high enough to overcome the voltage drop of zener diode ZD3, and current is supplied to the base of Q1 via resistor R1, turning this transistor on. This will hold Q2 off and the voltage at pin 12 of IC1 will be pulled high through R4, indicating that all phones in the installation are hung up.

Under these conditions, the circuit can be programmed and dial out will not occur. If a phone is in use, the phone lines will have a voltage of around 8V, and Q1 will be turned off as there is insufficient voltage to forward bias ZD3. As a result, Q2 will turn on, as base current for this transistor will be supplied via R4. The voltage at pin 12 of IC1 will now be approximately zero



The layout diagram shows all options. If you fit every component, tone or pulse dial can be selected simply by fitting the relevant links – allowing it to be changed at a later date. The 'one-key' section is shown on the right of the dotted line.

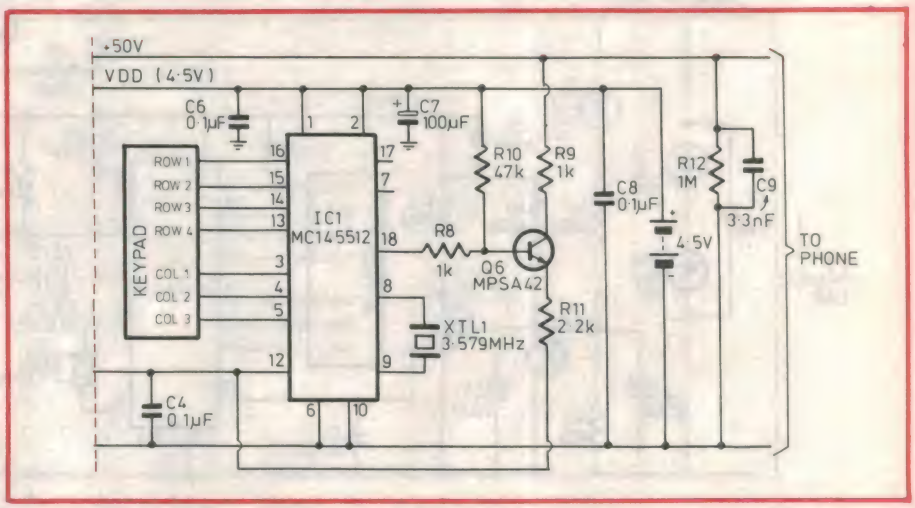
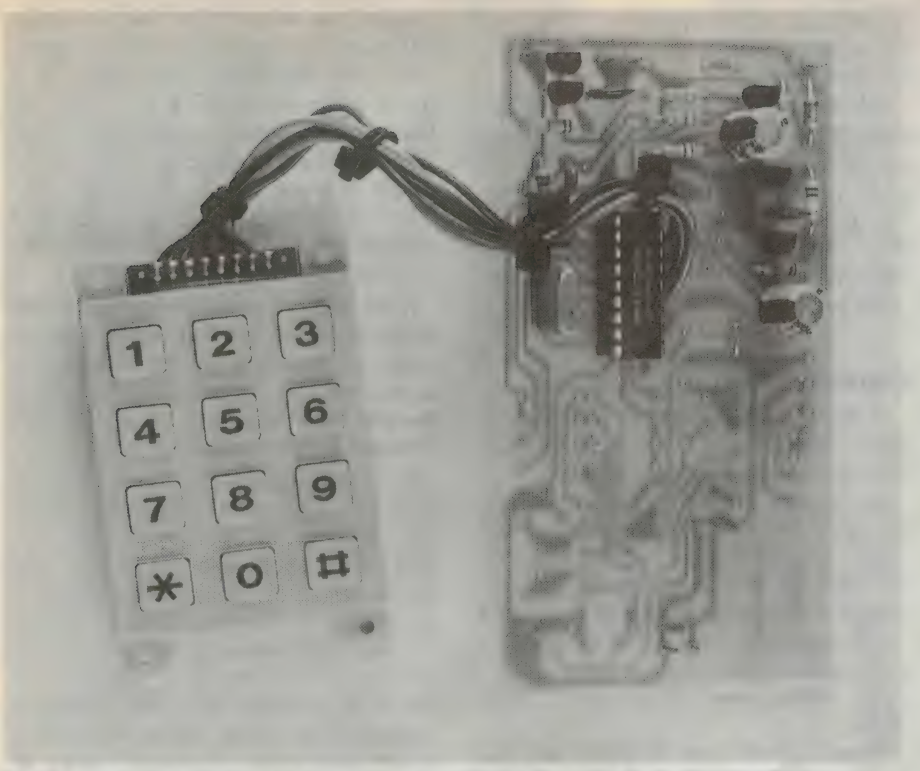


Fig.2: The tone dialling section is shown in this circuit. IC1 produces a tone dial output at pin 18 and Q6 impresses these onto the phone line via R9. Note that pin 10 of IC1 is grounded, and that the emitter of Q6 connects to pin 12.



The basic pulse dialler is shown here, without the single button option.

volts, indicating a phone is off the hook. In Fig.2, resistor R11 is connected to this pin as well, and it will now have a connection to the common line via Q2.

The tone dialling section is shown in Fig.2, and as it is the simplest circuit, we'll discuss its operation first. The crystal controlled oscillator within IC1 is used to generate the fairly precise high and low tones needed for tone dialling. When a key is pressed on the keyboard, IC1 converts its numeric value into the required high and low tones. These tones appear at output pin 18, where they are buffered by Q6 before being impressed onto the phone lines via R9.

In a pulse dial system, ZD3, Q1 and Q2 perform the same function as already described, except now capacitor C2 needs to be considered. Pulse dialling phones work by making and breaking the connection between the phone and the phone line, in which the phone is a low resistance. When a number is dialling out, the voltage across the phone lines varies from about 8 volts to around 50 volts while the dialling pulses occur.

However, as already described, Q1 and Q2 place IC1 on and off hook depending on the voltage level of the incoming phone lines. During pulse dialling Q1 and Q2 would effectively cycle IC1 between the on- and off-hook conditions, if C2 were not included. C2 prevents this by discharging quickly through R2 when the phone is off the hook and by charging more slowly through R1 when the phone is back on the hook.

When the voltage at the cathode of ZD3 rises to 50 volts, C2 is charged via R1, holding Q1 off until C2 is sufficiently charged. Thus, the off-hook condition is indicated for several hundred milliseconds, and the on-hook condition is registered only when the phone lines are stable at 50V for a time exceeding this delay. As the dial pulses are relatively short, the off-hook condition will be retained during the dialling process, and it will take a fraction of a second for on-hook to be detected after the phone is hung up.

The dialling pulses appear at pin 17 of IC1. Normally, this pin is an open circuit, and transistor Q5 will be turned on by the current flowing in R7. Under these conditions, the Darlington pair comprising transistors Q3 and Q4 will be turned on, effectively connecting the phone to the phone lines.

When a number is being dialled out by IC1, pin 17 cycles between a low and the usual open circuit condition for each dial pulse. This causes the phone to be alternately connected and disconnected during each cycle of the pulse stream, producing the required output pulses – providing the phone is off the hook.

When any key is pressed, pin 7 of IC1 outputs a short burst of 500Hz oscillation, and a piezo buzzer can be connected to this pin to give audible feedback. This is not used in the tone dialler as the dialling tones can be clearly heard in the telephone handset.

To minimise the effects of noise on the telephone lines, several decoupling capacitors have been connected at various points in the circuit. Noise is particularly bad during storms, and the usual rules of avoiding phone conversations during storms still apply.

The last section, shown in Fig.3, is the single button dialler. This circuit creates the sequence of pressing the recall key (* key) followed, after an ap-

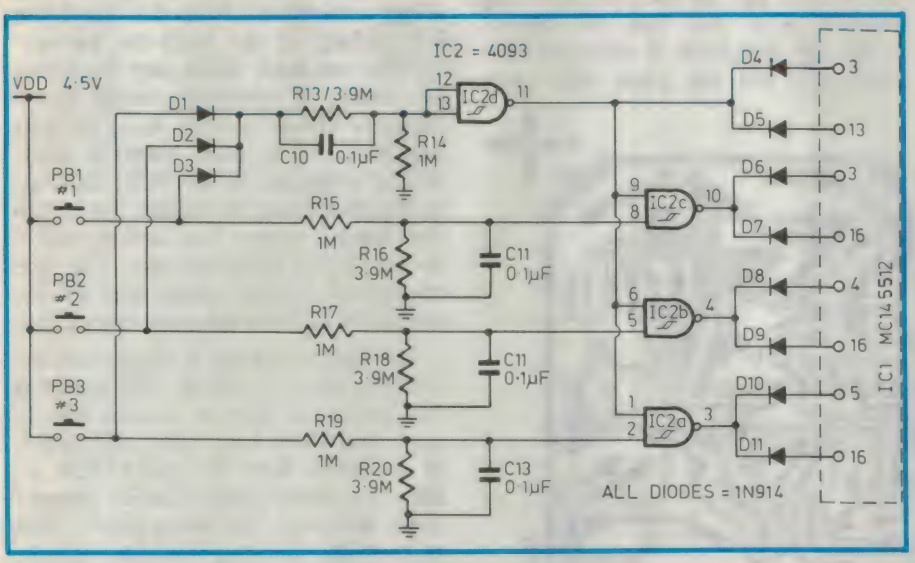


Fig.3: The single button dial feature is provided by this circuit, in which the sequence of pressing the recall key and numeral keys 1, 2 or 3 is created by time constants when either of the three pushbuttons are pressed. The circuit is in parallel with these keys on the keyboard.

propriate delay, by either keys 1, 2 or 3, depending on which button is pressed.

When either of the three pushbuttons PB1 to PB3 are pressed, a logic high is fed to the diode OR gate comprising diodes D1 to D3. A high is also passed to resistors R15, R17 or R19, depending on which of the three buttons is pressed.

Assuming PB1 is pressed, a logic high will be passed to IC2d via D3 and the differentiating network of C10 and R14. The output of IC2d will therefore go low, forward biasing diodes D4 and D5, placing a low at pins 3 and 13 of IC1. This simulates pressing the recall key, and IC1 will be set to accept the next number key as a memory location key. This occurs for any of the three buttons.

While the output of IC2d is low, NAND gates IC2a to IC2c will all have one input low, causing their outputs to be held high. This prevents them responding to a button press and generating a key code additional to that being provided by IC2d. After a short delay, C10 will be fully charged and the voltage across R14 will drop to become a logic 0 at the input of IC2d. As a result, the output of this gate will return to a logic 1, and diodes D4 and D5 will again be reverse biased.

While PB1 is being pressed, C11 will charge through R15, preventing pin 8 of IC2c from receiving a logic high until C11 is sufficiently charged. Assuming the output of IC2d has now returned high, the output of IC2c will go low when C11 has been sufficiently charged. This places a logic 0 at pins 3 and 16 of IC1, representing numeral key 1 on the keypad and IC1 responds by dialling out the number stored in memory location number 1.

When the button is released, C10 discharges through R13 and C11 discharges via R16, returning the circuit to its quiescent state, ready for the next button press. The delays are relatively short, and the number will be dialled out within milliseconds of the button being pressed.

Construction

A kit of parts for this project is available from CTOAN Electronics for $22. (See details at end of this article).

As already described, the circuit can be wired to suit your needs. The first option is tone or pulse dialling, and you will need to determine the type of exchange/PABX your phone is connected to. Remember, that a tone dial system will still work with a pulse dialler, but a pulse system won't work with a tone dialler.

To tell which type of phone line you have, dial a number and listen to the earpiece. If a series of tones can be heard, the phone, and therefore the system operates with tone dial. Pulse dialling will give a series of clicks, although this may not identify if the exchange is tone or pulse operated, but simply that the phone is pulse dial. However, it is safest to assume the system is pulse dial, as very few exchanges are tone dial as yet.

The PCB accommodates both dial modes, and the simplest method is to install all components and insert relevant links to wire up the type of dialling required. This way you can always change the dial mode if necessary. Alternatively, you can place only those components needed for the particular dial mode, saving components and time.

For tone dial, delete transistors Q3, 4 and 5, and resistors R5, 6 and 7 (Fig.1). Three links, referred to as links 1, 2 and 3 on the layout diagram need to be added, in which link 3 effectively shorts Q3. For pulse dial, leave out Q6 and resistors R8 to R11 (Fig.2). Also, links 1, 2 and 3 are no longer required.

If the single button dial option is not required, leave out all those components on the right of the dotted line shown on the layout diagram. Note however that capacitors C6 and C8 are included for all configurations.

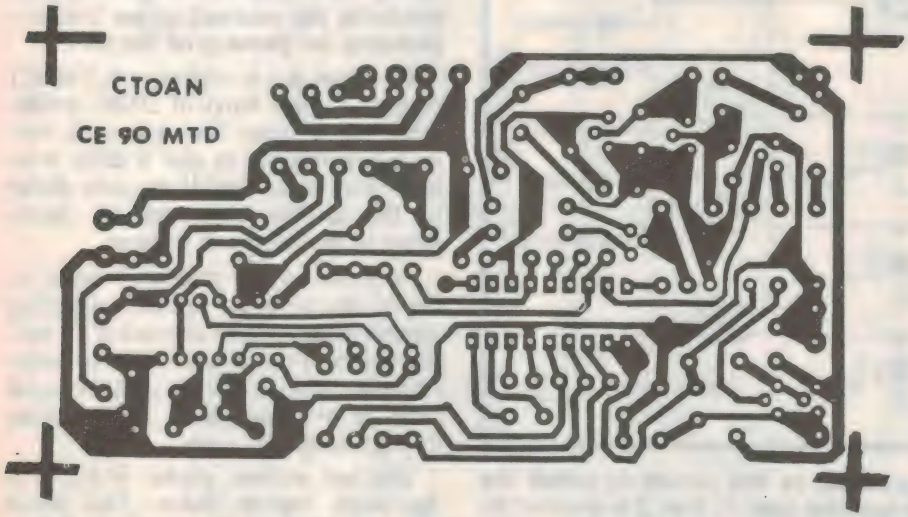
Start construction by examining the PCB for faults, then fit the links, resistors, diodes and capacitors. Take care with the orientation of C2 and C7 and the diodes. If the single button dialler is not included, the only diodes required are the three zener diodes. There are two links fitted on the copper side of the PCB, although only one of these is needed if the single button dial facility is not being used. If you are using IC sockets, (recommended) solder these in as well.

Next fit and solder all transistors. There are three types of transistors used in the circuit, and as they all look the same, make sure you identify them correctly and that they are mounted the right way. Note particularly that Q5 and Q6 are MPSA42 types, and Q3 and Q4 are MPSA92. As a guide, all transistors except Q6 (fitted for tone dial only) face the same way.

The keypad can now be wired, using different coloured wires for each of the seven connections. Note that pin 1 (on left looking at the rear) on the keyboard is not used. Make sure the wiring is correct, as otherwise wrong phone numbers will be dialled! Also, the battery pack and the piezo buzzer (if used) can be connected to the PCB. Then attach a phone plug to connect the unit to the normal phone line socket and a socket to plug the phone into. Use flexible two-core phone wiring of a suitable length for both the plug and the socket.

The crystal and the IC(s) are the last components to be fitted. The crystal is not polarised, but be careful not to apply too much heat when soldering it to the PCB. Both ICs are CMOS, so take the usual precautions to prevent static discharge destroying them. That is, earth the soldering iron if the ICs are being soldered directly to the PCB, and discharge yourself by touching an earthed appliance.

After checking your construction, the



A full size copy of the PCB artwork for those who want to make the board themselves.

unit can be tested. Note that the circuit is powered by a 4.5V battery pack. This will require a battery holder that takes four batteries to be modified, to allow it to accommodate the three 1.5V batteries needed. The dialler is connected between the phone and the line socket, but first the polarity of the phone wiring must be checked.

Telephone connections

These days, most phone installations have more than one phone. The main phone will have two wires coming into the socket from the phone system, but a third wire may be used from this socket to the extension sockets. This line is used to prevent other phones from tinkling when dialling out, and runs from the main phone to the extension phones. However new installations usually only have two wires. More on this later, as first we need to discuss the *polarity* of the wiring at the socket.

The main phone lines connect to terminals 2 and 6 in a phone socket, and as it doesn't affect the operation of a phone, there is no standard for the polarity of the wires connected to the socket. However, polarity *is* important for the memory dialler. We tried adding a bridge rectifier to ensure the polarity to the PCB would be correct regardless of the wiring at the socket, but this caused problems in some installations due to the voltage drop across the diodes.

The incoming phone lines have a potential of around 50V DC, and the positive line must connect to the cathode of ZD1. This is easily checked with a DC voltmeter, but note:

- *Approximately 100V AC will occur when a ring signal comes in. This is sufficient to give an electric shock, so be careful!.*

If you connect the phone lines to the unit with incorrect polarity, no damage will occur to either the phone lines or the circuit of the dialler. Instead, the voltage across the phone lines will drop to around 1.2V, due to diodes ZD1 and ZD2 being forward biased. When the polarity is correct, approximately 50V DC will be present between the phone lines. In other words, simply connect the phone lines so that 50V DC is measured between them when all phones in the installation are on hook.

In a three-wire system, to avoid extension phones tinkling when dialling out, connect the dialler to the last phone in the installation. If the system only uses two wires, it doesn't matter which phone is used. Alternatively, the third wire from the main phone can be run so that it connects back to the wall socket, but bypasses the dialler.

Once the unit is connected, all that remains is to test it. The phone should operate normally, but now you should be able to program numbers into the memory dialler, and also dial out using either the keyboard or the memory in the unit.

If it doesn't work, carefully check that the PCB has been loaded correctly and that all polarised components and the ICs are mounted the right way. As a further check, the current consumption from the battery pack with the unit connected to the phone lines should be no more than 80uA or so. *Remember also that the supply voltage from the battery pack is 4.5V, not 6V.*

Transistors Q3 to Q6 are all high voltage types, and should be replaced with the specified type. Otherwise, there is not much that can go wrong, unless an IC has been damaged when building the unit.

If the batteries supplying power to the unit are disconnected, numbers stored in the memory will be wiped. When replacing the batteries, numbers will need to be re-entered, unless you can maintain the supply during the changing process. Also, for the pulse dial unit, the phone connected to the dialler will not function if the batteries are flat or disconnected. This is not the case for the tone dial configuration, as there is always a direct connection to the phone from the phone lines.

Completing it

Once everything is working, the unit can be fitted inside the case. In the prototype, we cut a rectangular section out of the jiffy box lid to accommodate the keyboard, and glued it to the underside of the lid. Exit holes for the input and output leads need to be cut, and holes for the pushbuttons (if fitted) are drilled in the lid of the box.

The PCB and the battery pack sit inside the box, with the battery pack underneath. A piece of insulating material between the PCB and the battery pack will prevent electrical contact between them. Press-on lettering can be used to label the lid, and the unit is then ready for use.

PARTS LIST

1 PCB 105 x 57mm, coded CE90 MTD
1 piezo buzzer
1 3.579MHz crystal
1 10-key keypad
1 telephone socket
1 telephone plug
1 plastic jiffy box, 125 x 54 x 40mm
3 normally open pushbuttons
1 4.5 volt battery pack (3 x AA cells)
Telephone cable, plug and socket, hookup wire etc.

Resistors

All 1/4 watt 10%:

R1,6	330k
R2	10k
R3,4,5	100k
R7	220k
R8,9	1k
R10	47k
R11	2.2k
R12,14,15,17,19	1M
R13,16,18,20	3.9M

Capacitors

C1,3,9	3.3nF 100V polyester
C2,7	100uF 16V electrolytic
C4,5,6,8,10,11,12,13	0.1uF monolithic

Semiconductors

Q1,2	BC548
Q3,4	MPSA92
Q5,6	MPSA42
D1-11	1N914
IC1	MC145512 memory dialler (Motorola)
IC2	4093 quad Schmitt NAND
ZD1,2	68V 1W zener diode
ZD3	15V 1W zener diode

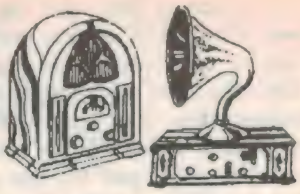
A kit of parts for this project is available from CTOAN Electronics for $22 plus $2.50 post and packing. The kit includes the PCB, keypad and all components for the tone/pulse dialler. It does not include the components for the single button option, the case, telephone plug, socket and cable. The components for the single button option cost an extra $7.

A repair service is available for $10.00 (plus $2.50 P&P), providing the kit has been constructed in a reasonable manner. This cost includes replacement of IC1, providing an IC socket is used. Both the kits and repair service are available from:

CTOAN Electronics,
PO Box 33,
Condell Park, NSW 2200
Phone (02) 708 3763

Vintage Radio

by PETER LANKSHEAR



National's legendary 'HRO'

Arguably the best known communications receiver of all time is the instantly recognisable National HRO. Technically very advanced at the time of its introduction, it combined mechanical and electrical excellence and remained in production with minimal changes for 30 years. Its concepts influenced communication receiver design right to the end of the valve era.

First some background to the advent of the HRO. In the January 1990 column, we showed how in 1929, the Pilot 'Super Wasp' was a major advance shortwave receiver design.

With such success, it was not long before the Super Wasp had competition. Within a year, the National Company of Malden, Massachusetts - in consultation with Robert Kruse, the Super Wasp's designer - had introduced the SW5 'Thrill Box' regenerative TRF shortwave receiver. With ganged tuning, and very smooth regeneration controls for a tetrode detector, the SW5 was a definite, but somewhat expensive advance on the Pilot receiver.

National, under the leadership of James Millen, a gifted mechanical engineer, had already established itself with its Browning Drake receivers as a maker of superlative components, an important factor in the success of the SW5. America's fledgling commercial aviation authority was setting up a communications network and chose the SW5 for its ground stations, an endorsement of the quality of National equipment.

Although by 1932 the superheterodyne dominated American domestic radio, there were still serious doubts as to its worth for shortwave work. However in April of that year, Hammarlund, National's competitor in quality products, released their 'Comet Pro' for communications work.

Covering from 1500kHz to 20MHz with plug in coils and with a beat frequency oscillator, the Comet Pro proved that a superhet communications receiver could be a viable proposition. Despite being without a radio frequency amplifier stage preceeding the mixer, and initially also without automatic gain control, the $88 Comet nevertheless confirmed the operational superiority of the superhet over the less selective regenerative TRFs.

Meanwhile, aviation radio was changing from CW (Morse) to radio telephone, and for this the SW5 was proving to be inadequate. At the request of the US Department of Commerce, National developed the Airport Ground Service (AGS) superheterodyne. Not only did this have an RF stage and AGC, but it featured a crystal IF filter, which had first appeared in 1930 in the English 'Stenode' superhet and publicised in America by the the amateur magazine *QST*, to provide remarkable selectivity.

The 'AGS' used three plug-in coils for each band, and covered a frequency range of 1500kHz to 20MHz. This receiver was a winner, but only the affluent could afford the cost of more than $200.

To cater for hams, in February 1933, National provided what was essentially a cut down AGS. Named the 'FB7', it had no RF stage or power supply, the BFO and crystal filter were optional, and the basic cost without valves was a much more affordable $33.

Late in 1933, with the knowledge already gained, National started work on a revolutionary new 'state of the art' receiver later to be known as the 'HRO'.

Split development

The distribution of the teamwork was unusual, but effective. Mechanical design work was the responsibility of a group located at National's headquarters in Massachusetts, while electrical research was undertaken by a laboratory in California. After specifications had been agreed to, each team concentrated on its own objectives without interference from the other, which otherwise may have compromised results.

The prime requisites for communications receivers, especially those with mechanical tuning, are solid construction and precision tuning drives, and no firm was better qualified to make these than National. Electrical design requires a mastery of circuit theory and a practical knowledge of operating, both qualifications of the Californian team.

The specifications were stringent. The

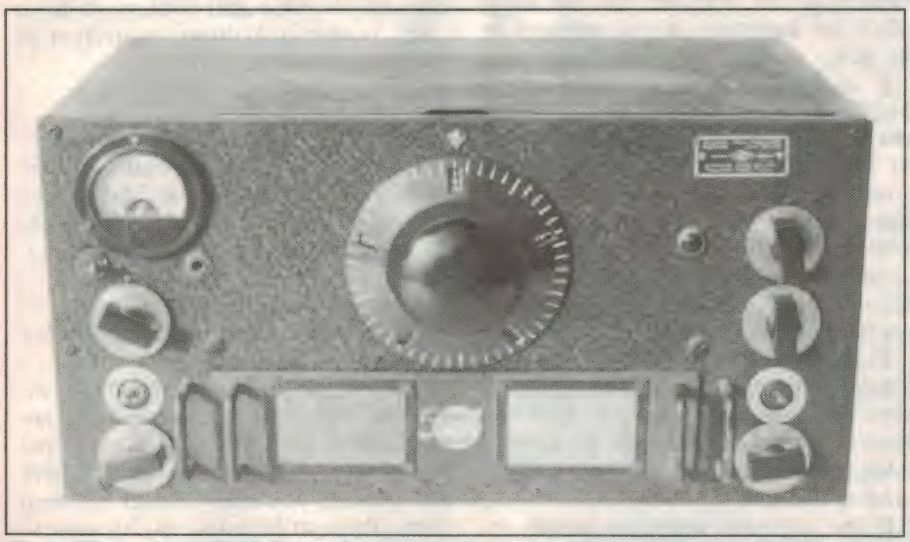


Fig.1: The unique 'PW' dial and plug-in coil boxes make the National HRO instantly recognisable. This wartime version is very similar to the original model of 1934.

proven IF transformers and Lamb crystal filter from the AGS were used without change. Trimmers and padders had air dielectrics. Typical of the quality of components, coil formers were moulded from powdered mica bonded in a bakelising process and grooved.

To give the greatest possible signal to noise ratio and protection from images, two RF stages were specified - at that time virtually unheard of in a superhet.

Band switching was too inefficient to be considered. Instead, in a unique system, the coils for each band, along with their padders and trimmers were mounted in rectangular boxes and assembled in sets of four on front plates to provide plug-in units. Contact studs on the boxes mated with fingers under the tuning capacitor, providing very short connecting leads.

These coil assemblies were plugged into the front panel, requiring the tuning capacitor to be mounted longitudinally, parallel to the panel. Consequently, a right angled drive was necessary, incorporating what was to become the famous 'PW' drive.

National trademark

If ever a component became an instantly recognisable company trademark, it was the unique National PW dial, an integral part of the PW assembly. As the dial rotated, the calibrations appeared through slots in its face.

Essential specifications were calibration accuracy, mechanical bandspreading and no backlash. A gearbox with a 20:1 heavily spring loaded worm drive was coupled to the epicyclic geared dial drive, having a readout capability of one part in 500 and an effective scale length of 12 feet! Most importantly, dial settings were repeatable.

The whole assembly was massively constructed. The 3/8" rotor shaft had bronze end bearings, insulated to reduce noise and alignment was maintained by four radial bearings. Stators were insulated with the promising new 'Steatite' ceramic. Each rotor section was insulated to improve stability by isolating earth returns.

The whole rigid assembly of tuning capacitor, gearbox and dial was an independent unit. Consequently, any racking or warping of the chassis had no effect on tuning.

The position of the tuning coils at the bottom of the chassis minimised, but did not completely eliminate drift from heating. Further efforts to reduce drift included making oscillator trimmers with a combination of aluminium plates, brass spacers and steel studs.

Chief among the heat reduction fea-

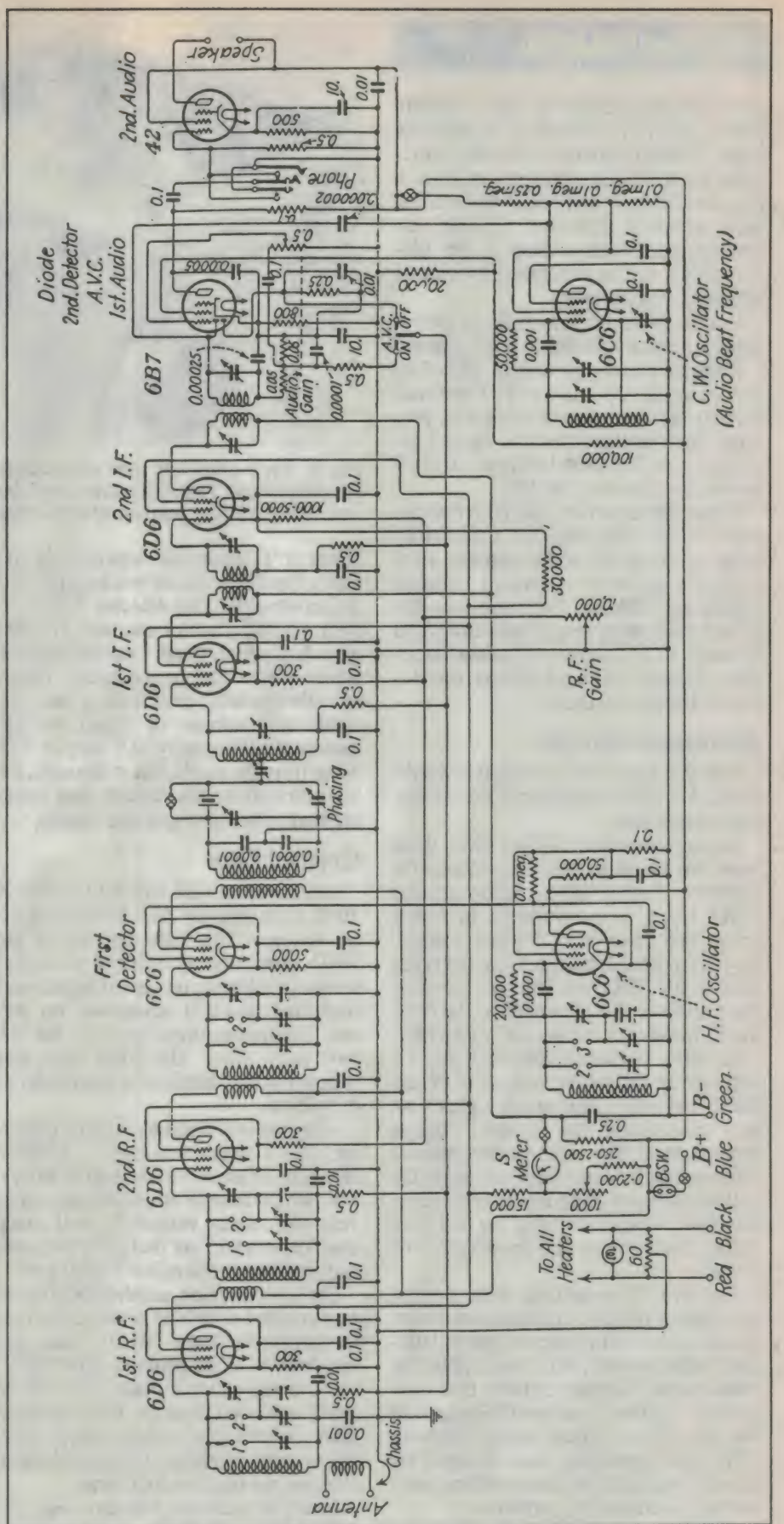


Fig.2: A classic example of sound design, there were no shortcuts or skimping of components; but neither were there any unnecessary frills. Originally 2.5 volt valves were recommended for mains operation.

tures was the decision to use a separate power supply connected by a five-foot cable. Further benefits from this somewhat inconvenient arrangement were a reduction in hum and noise; but as most hams provided their own supplies, uncompensated voltage drop in the filament leads was an unsuspected source of degraded performance.

Just as there was no built in power supply, neither was there a loudspeaker.

Frequency coverage was simplified by the plug-in coil system. Optional bandspread for amateur work was provided by shorting screws in the coil assemblies, so that each band started at 50 on the dial and ended at 450.

When connected for general coverage, each set of coils provided a frequency range of about 2:1 and eventually were available to cover anywhere between 50kHz and 30MHz. Each coil box displayed calibrating graphs translating dial readings to frequency - a somewhat archaic system that nevertheless was accepted happily by users.

Advanced circuit

A detailed study of the circuit is worthwhile, but first a word about the American valve series.

During the period 1932 to 1935, there were two 'standard' filament voltages for indirectly heated valves. Many popular valve types were available in either range, and apart from filament voltage, they were interchangeable. Of the types used in the HRO, the 2A5 was identical electrically to the 42, the 58 to the 6D6, the 57 to the 6C6 and the 2B7 to the 6B7.

Initially, National specified the 2.5 volt series for mains operation of the HRO. Although their much higher current exacerbated the filament voltage drop problem, they were quieter, particularly around 15MHz where the early 6D6 valves produced modulation hum. Later this fault was cured and the 6.3 volt valves became standard for all types of service.

The two RF amplifiers were similar, and typical of good conservative design practice. For AM phone reception, automatic gain control (AGC) was applied to both stages. Variable cathode bias control was used for the second RF stage and the two IF amplifiers when receiving CW. Band spreading was obtained by transferring switching screws from internal coil terminals 2 to terminals 1.

Although the pentagrid converter became available during the development period, the superior combination of a separate oscillator and biased pentode mixer or 'first detector' was used for the HRO. Oscillator output was injected into the screen of the first detector. The oscillator was the Dow or electron- coupled type, basically a Hartley circuit with the screen grid acting as the anode. Given suitable operating conditions, it was very stable and immune of supply voltage variations. Normally the output was taken from the anode, but in this case, the waveform from the cathode had fewer harmonics to cause spurious signals.

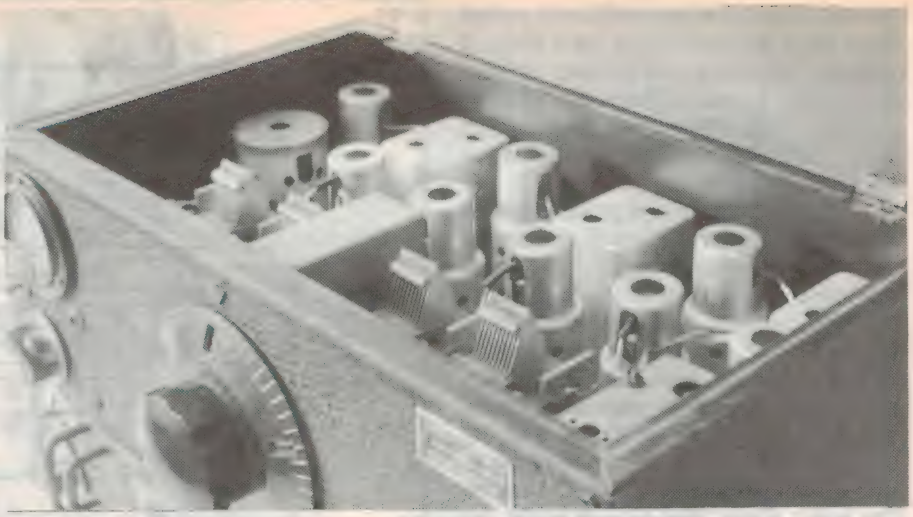


Fig.3: Very compact, the construction of the HRO left little room for later modifications. The PW gearbox can be seen between the two halves of the tuning capacitor. Early models had cylindrical IF tuning capacitors.

Crystal filter

Publicised by *QST* editor J.J. Lamb in 1932, the extremely selective crystal filter following the first detector of the HRO gave the operator a powerful means of rejecting unwanted signals and remained standard equipment on any real communications receiver for the next forty years. The HRO filter was claimed to be capable of a bandwidth of only 20Hz.

A specialised version of tuning indicator, the 'S' meter was part of a bridge circuit in the anodes of the two IF valves. The two 500kHz IF amplifiers were conventional, using extremely well made transformers with air dielectric trimmers and provided much of the overall gain.

For CW reception, another (6C6) electron-coupled oscillator acted as the beat frequency oscillator (BFO). Next was the double- diode-pentode valve (6B7) performing several tasks. One diode acted as second detector, BFO injection point, and the AGC voltage source. During manual operation, the second diode clamped the inactive AGC line.

Plenty of audio amplification was provided by the resistance- coupled pentode section of the diode-pentode, feeding either the output stage or headphones. Finally, a standard output pentode (42) was provided to drive a loudspeaker. To avoid damage to the output valve, it was important to leave a speaker connected at all times.

The classic concept of the HRO, with its two RF stages, an oscillator/mixer followed by a crystal filter and two IF stages, BFO, detector and audio amplifier was so successful that it became almost a *defacto* standard for generations of high performance single-conversion communication receivers.

The HRO at work

First release of the HRO was during November 1934. It exceeded the aviation industry's specifications, and for the affluent who could afford the list price of $233 (less 40% discount for hams) it was the ultimate experience. One unusual aviation application was operating without tuning dials in remote fixed tuned receiver installations.

Meanwhile, other manufacturers were not idle and before long many manufacturers including Hammarlund, Hallicrafters, Patterson, RME, and RCA were in competition. Their receivers all had band switching and direct reading dials. Nevertheless, the qualities of the HRO were such that it needed only a few minor modifications to retain its popularity. A further boost came in 1938 when Howard Hughes installed HRO receivers for his flight around the world.

World events then conspired to guarantee immortality for the HRO. In 1939 at the outbreak of war, Britain desperately needed communications receivers and all available HRO's were rounded up. The Admiralty found them to their liking and ordered a shipment from America. When America herself was put on a war footing, the HRO was in great demand by the armed forces and large

numbers were made. Many of the HRO receivers to be found today, including the model pictured, were made at this time.

Even after 1946, the HRO remained a popular receiver. Naturally, modifications were made over the years, but right until it was finally withdrawn in the mid 1960's, the HRO with its magnificent PW dial was instantly recognisable.

Many imitations

If imitation is flattery then the HRO had plenty of admirers, for during World War II it was copied in a remarkable number of instances. Both the Germans and Japanese are reported to have made recognisable versions, but there are examples nearer home. Australia's Kingsley produced the 'AR7', and AWA the 'AMR-100'. Physically, these were HRO receivers, with equivalent specifications - although there were differences in valve types and circuits.

Less well known is that New Zealand too made HRO replicas. Collier and Beale produced some excellent models, using high mutual conductance TV valves in the front end. I well remember using a rack mounted set of three, arranged for triple diversity reception. When connected to three widely spaced aerials and tuned to the BBC's Pacific Service, the results were most impressive at the time.

AWA made an unusual receiver that looked like an HRO but wasn't! Using the traditional panel layout, PW dial and plug in coil boxes, it was a radio station monitoring and rebroadcast receiver, with only a single RF stage and very broad selectivity.

Collecting the HRO

The HRO is considered by many to be the most collectable communications receiver. Most common are the wartime models. However, be warned. Many of these receivers were understandably snapped up by amateurs. Hams, traditionally, are strivers for the ultimate and HRO's are quite likely to be found in much-modified condition. Provided that no mutilation has taken place, restoration is possible, but extra holes and missing components can tax even the most skillful restorer.

Finally how did the HRO get its odd name? Legend has it that the factory staff were under considerable pressure to push the development along. As the administration hadn't caught up sufficiently to issue a job code, the staff invented their own, writing on their time sheets 'H.O.R.', standing for Hell Of a Rush. The term HOR stuck, until someone felt that HRO sounded more circumspect.

Solid State Update

KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

Single chip AT for 286-based PCs

A new AT single chip, operating at speeds up to 20MHz, for IBM PC-AT compatibles has been announced by Texas Instruments. Designated the TACT82411, the single chip integrates system logic and most peripheral functions, such as interrupt controller, timer and real-time clock.

Only seven logic devices plus memory, CPU, and math co-processor are needed to complete an 80286 PC board. The TACT82411 is packaged in a 208-pin quad flat pack.

Desktop systems users will now have a natural evolution to a single chip to minimise space, reduce cost and increase system performance. More importantly, a single chip that requires minimal glue logic and operates at 20MHz is ideal for laptops.

Key chip features include separate CPU and AT bus clocks for asynchronous AT bus operation; software configuration for wait states, command delays, and memory organisation; real-time clock and 128-byte CMOS configuration RAM; single-bank page mode which allows less expensive DRAMs to be used; and 2-way and 4-way page interleave mode with 64K, 256K and 1M DRAMs, including 1M x 4.

For further details circle reader information service number 273 or contact Texas Instruments, 6-10 Talavera Road, North Ryde 2113, phone (02) 887 1122.

Low skew clock driver for RISC

Motorola has introduced the MC88913 low skew clock driver, the first device in a planned series of high-performance CMOS clock driver ICs.

Responding to needs in many applications for input clock duty cycles held tightly to 50%, the MC88913 device contains six divide-by-two flip-flops driving four non-inverting and two inverting outputs having closely-matched propagation delays. As a consequence of the matched propagation delay feature, the duty cycles of its output waveforms are symmetrical within 1ns, making it ideal for 88000 RISC or other CISC/RISC applications.

The maximum frequency of the input clock to the MC88913 device is 110MHz, thereby allowing it to drive processors with low-skew clock signals up to 55MHz. Its six flipflops are triggers on the positive edge transition of the input clock, which may have a minimum high or low pulse width of 3ns. Each of the six output lines is rated at a sink/source drive capability of 24mA.

For further details circle reader information service number 280 or contact Motorola Semiconductor Products, 673 Boronia Road, Wantirna 3152, phone (03) 887 0711.

2MHz 12-bit sampling A/D

Micro Networks has announced a new sampling A/D converter, the MN6249. This device combines the performance of the MN5249/12-bit, 400ns A/D) with that of the MN376 (200ns T/H) to create a single package solution for digital signal processing applications.

With a 2MHz minimum sampling rate, 12-bit resolution and on-board T/H amplifier, this device is targeted for the most demanding military/aerospace and high-end industrial applications, some of which include spectrum, vibration, waveform and transient analysers, radar, sonar and video digitsers, medical imaging equipment, digital filters, and multiplexed or simultaneous sampling data acquisition systems.

Packaged in a small 40-pin DIP, this new addition to the sampling A/D converter family is fully specified and tested for DSP-type applications, 68dB SNR and –72dB harmonics are realised while digitising a 1MHz full scale input signal, at a minimum sampling rate of 2MHz.

The MN6249 operates from +15V, +5V and –5.2V supplies and consumes 3.5W typically. The devices' digital inputs and outputs are TTL compatible and digital outputs can be enabled/disabled via on board 3-state output buffers. FFT testing and DSP-type specifications guarantee frequency-domain performance.

For further details circle reader information service number 277 or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191, phone (03) 521 0266.

Low leakage CMOS multiplexers

Veltek has introduced the MAX328/MAX329, the industry's lowest leakage CMOS monolithic multiplexers, which are pin compatible with the DG508A/DG509A. The MAX328 is a single-ended 1-of-8 mux, and the MAX329 is a differential 2-of-8 mux.

The MAX328/MAX329 offer low leakage (typically IS(off) = .1pA and ID (off) = 1pA), a wide operating range of power supply voltage (a single supply of +10V to +30V, dual supplies of +/–5V to +/–18V, or any unbalanced combination with a total of 10V minimum), and low power consumption (1.9mW with +/–15V supplies).

Both devices are fault-tolerant multiplexers able to indefinitely withstand 120V AC fault voltages, and are accurate to a minimum of 16-bits over temperature.

MAX328/MAX329 applications include control systems, data logging systems, aircraft heads-up displays, signal routing, and data acquisition systems.

For further details circle reader information service number 274 or contact Veltex, 22 Harker Street, Burwood 3125, phone (03) 808 7511.

Efficient blue semi laser

IBM researchers have generated blue light from a semiconductor laser with an overall efficiency of 10% – much higher than previously attained. Existing gas lasers typically achieve efficiencies of only 0.1% for blue light output.

As yet, most semiconductor lasers have produced red or infrared light, which have less photon energy than blue light because of the lower frequency. The longer wavelengths are also less capable of being focused into a smaller spot, than is blue light. Hence although semi lasers have become widely used as sources in optical communications and laser printers, they have been relatively unsuitable for use in promoting chemical reactions or in recording and reading back data on optical discs.

In IBM's new technique, 856nm infrared light emitted by a conventional semiconductor laser is circulated through a potassium niobate crystal, which doubles the frequency by harmonic generation. The blue light thus created has a wavelength of 428nm, and by careful stabilisation of the laser frequency and matching this to the resonant frequency of the crystal, the IBM researchers have achieved a harmonic conversion efficiency of 39%.

Tone pulse/dialler

The UM91230 is a tone/pulse switchable dialler with 32-digit redial memory. Switching from pulse to DTMF mode can be accomplished either by using a slide switch or by depressing the 'T' key.

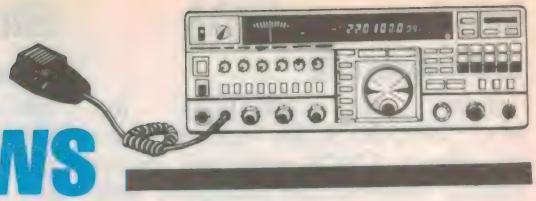
The necessary dual-tone frequencies are all derived from a 3.58MHz TV crystal, thus providing high accuracy and stability. The sinsoidal waveform for each individual tone is digitally synthesised on the chip. Waveforms thus generated have low total harmonic distortion (5% max.).

A reference voltage is generated on the chip, which is stable over the operating voltage and temperature range. It regulates the signal levels of the dual tones to meet telephone industry specifications.

CMOS technology provides very low power requirements and high noise immunity. This device can be easily interfaced with a variety of telephones, requiring only a minimum number of external components.

For further information circle 283 on the reader service coupon or contact Zitech Electronics, 57 St Hellier Street, Heidelberg Heights 3081; phone (03) 459 7222.

Amateur Radio News



WICEN (NSW) holds AGM

The NSW WICEN (Wireless Institute Civil Emergency Network) organisation held its second Annual General Meeting in late August, at Amateur Radio House in Parramatta. About 30 people attended, with representatives from the Hunter and Central Coast areas.

Office bearers elected unopposed were Ian VK2BIN as President, Brett VK2XMU as V-P, Peter VK2EMU as Secretary and Tim VK2ZTM as Treasurer. Steve VK2DNN continues as State Co-ordinator.

Historical QSL cards wanted

The WIA's VK2 Division maintains a collection of various historical records regarding amateur radio in the state, including a collection of old and rare QSL cards.

The Division's honorary historian Jo Harris, VK2KAA is always keen to acquire additional cards for the collection – especially if they're of special significance for VK2. Jo can be contacted via the NSW divisional office on (02) 689 2417, or direct on (02) 489 4393.

Jo can also use some help in looking after the card collection, and would appreciate a call from anyone able to assist.

Homebrew restricted in Canada

According to *AR* magazine, the new Canadian amateur radio licensing scheme prohibits all but the highest level of licence holder from building their own transmitting equipment.

Apparently the new 'Basic' licence permits operation on all bands above 30MHz, in all modes and with up to 250W output, but using commercial equipment only. Passing a 5wpm Morse test brings permission to operate on 160 and 80 metres, while passing a 12wpm test allows operation on all HF bands. But only the 'Advanced' licence allows use of maximum power, and the right to build one's own transmitting equipment.

Is this the start of a trend, to push amateur radio even further towards CB? EA

Sam Voron, VK2BVS sent us this picture, taken during his recent visit to the People's Republic of China on behalf of the International Amateur Radio Club of Sydney. It shows the operating desk of the Shanghai Children's Palace station BY4ALC, with station master Chen BZ4CW on the left, Zhou BZ4CQ on the right and a friendly customs officer in the centre. (Picture courtesy Amateur Radio Action)

NEW PRODUCTS

Programmable 3.75-digit DMM

Colourview Electronics has released the MIC-3200 3.75-digit multimeter, featuring analog bar graph plus a 'Range Alert' feature which allows the user to search circuitry for a specific (user programmable) level or range of levels, and activate an audible alarm when the set level is detected.

Other features include min/max memories, 40MHz logic probe with variable thresholds, dBm measurement, range hold to disable auto-ranging when desired, relative measurement mode and a 20A continuous current measurement capability. Also included as standard is a fast display mode, allowing sampling and display every 50ms instead of the usual 300ms.

For further information circle 257 on reader service coupon, or contact Colourview Electronics, 5 Commerce Street, Salisbury 4107; phone (07) 275 3188.

Triple output 60W DC-DC converter

Power General's DC60 series is a family of low cost, high efficiency, triple output DC-DC converters. Fabricated on a single printed circuit board, the units employ a state of the art 100kHz, MOSFET switching design to achieve their high level of performance and reliability.

Twelve models offer nominal inputs of 12, 24 and 48V DC with input voltage range of 9 to 18, 16 to 36, and 36 to 72V DC respectively. Single outputs of 5, 12, 15 or 24V DC are offered at a total maximum output power of 50 to 72 watts. Efficiency is as high as 85%, input/output isolation is 2500V DC and line/load regulation is typically +/–0.2%.

An external sync connection allows the user to synchronise the DC60 series to an external clock in order to improve overall system signal to noise ratio. An external, TTL-compatible disable allows for power conservation through remote shutdown. Under/over voltage shutdown and output short circuit protection are standard on all models.

For further information circle 243 on reader service coupon, or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Desolder station

The SA-600 desolder station is designed specifically for rework of boards with large thermal masses, including difficult multilayer boards. This system incorporates a high efficiency vacuum pump (21" Hg) with quick response suction, has a variable temperature range of 350°C to 450°C, and has the facility to use the pump for either suction or hot-air blowing.

The SA-600 combines a safe 20V handpiece with a 65W heating element for excellent heat recovery and temperature stability. High mass nozzles provide superior heat capacity, allowing efficient solder reflow at lower temperatures.

For further information circle 245 on the reader service coupon, or contact Electronic Development Sales, 2a/11 Orion Road, Lane Cove 2066; phone (02) 418 6999.

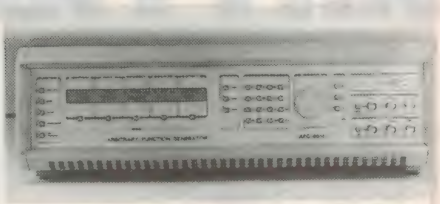
SMD 2.5mm inductor

Murata Manufacturing has released the BLM series of SMD solid inductors for EMI suppression.

The BLM series is claimed to be excellent in noise suppression from several MHz to several hundreds of MHz and to also prevent abnormal oscillation of high frequency amplifying circuits. A nickel barrier termination provides excellent solder heat resistance, making the components suitable for both flow soldering and reflow soldering.

The BLM21 has dimensions of 2.0 x 1.25 x 0.9mm, making them suitable for 2.5mm pitch SMD mounting. Typical impedance varies from 5 – 150 ohms at 100MHz and rated current of 500mA maximum.

For further information circle 247 on reader service coupon, or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 648 5455.



Function, arbitrary waveform generator

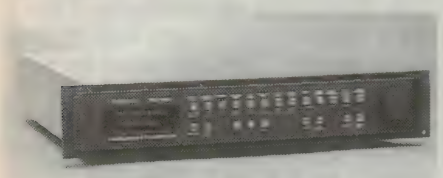
The AFG-8010 is a universal waveform source that offers all the features of a traditional 10MHz function generator, pulse generator and sweep generator as well as the advantages of an arbitrary waveform generator.

Arbitrary waveforms can be created in three ways: direct transfer of a captured waveform from a digital storage oscilloscope, downloading from a personal computer, or directly via the front panel keyboard.

As a function generator, the AFG has a frequency range of 10uHz to 10MHz in 10 decades, producing sine, square, triangle and TTL waveforms. Arbitrary waveform specifications include a deep 8192 point horizontal memory and a 12-bit (4096) point vertical resolution. Read out rates of the horizontal memory can be varied from 100ns to 100s per point. Both waveform repetition rate and amplitude may be varied as required.

The AFG's arbitrary facilities suit a wide range of specialised waveform generating applications in areas such as R&D, prototype testing, mechanical analysis, automotive and biomedical engineering. For example, once a signal has been captured on a digital storage oscilloscope, it can be "played back" on the AFG as often as required, after the data is transferred from the scope to the AFG via IEEE-488 bus.

For further information circle 244 on the reader service coupon, or contact Emona Instruments, 86 Parramatta Road, Camperdown 2050; phone (02) 519 3933.



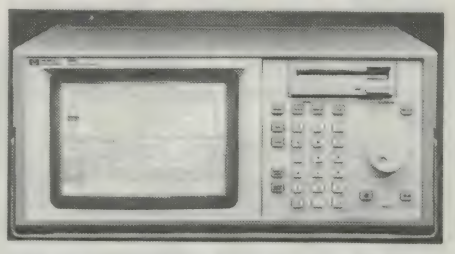
Programmable TV generator

The Tektronix TSG-1001 programmable TV generator is easy to use for multi-format environments, including HDTV. The TSG-1001 operates with Tektronix' SDP-1000 signal development package, a PC-based program for modification and creation of test signals, which is supplied with each TSG-1001 generator.

The SDP-1001/TSG-1001 combination provides a versatile platform for defining and generating commonly used and new television signals. The TSG-1001 can output signals from supplied libraries in NTSC, component (MII, Betacam, SMPTE, EBU), any proposed high definition format, or user defined formats.

Newly created signals or signals from the SDP-1000 libraries can be quickly downloaded to the TSG-1001 and output via analog and parallel digital paths. Downloaded signals are saved when the generator is off. A PC can be interfaced with the TSG-1001 for downloading through either an RS-232 port or an IBM PC or AT hardware compatible parallel port.

For further information circle 248 on reader service coupon, or contact Tektronix Australia, 80 Waterloo Road, North Ryde 2113; phone (02) 888 7066.



Logic analyser for 8 and 16-bit systems

Hewlett-Packard has introduced the HP1654B logic analyser with 64 channels, 100MHz timing analysis and 35MHz state analysis. The new instrument is designed to provide a low-priced logic-analysis solution for electronics-design engineers working with 8 and 16-bit microprocessor-based systems.

The HP1654B is the fifth instrument to join the HP1650 family of logic analysers, preceded by the HP1650B, 1651B, 1652B and 1653B. All series 1650 analysers have many standard features and functions in common, including 100MHz transitional timing analysis on all channels; 35MHz state analysis on all channels (except the HP1651B and 1653B, which have 25MHz state analysis; advanced pre and post processing analysis for state and timing data; a simplified user interface that provides users with only valid choices and eliminates menu-hopping; and full programmability via either HP-IB (IEEE-488) or RS-232C.

For further information circle 242 on reader service coupon, or phone HP Australia on (008) 033 821.

Wave soldering with profiled heat

The new Hollis PT400 series of wave soldering machines are designed to meet today's most exacting profiled preheat temperature standards. Controlled in three banks, 48 tubular infra-red radiants provide exceptional uniformity in preheat, to reduce thermal shock. The rods are metal-sheathed and mineral insulated and provide excellent profile control.

The PT400 features a first generation 'open architecture' design giving excellent maintenance access to all areas. Replacement parts are quickly detachable and easily isolated.

Control package features include digital solder-temperature control, analog preheat, conveyor, wave-height and flux controls. An automatic start/stop time clock is provided, in addition to solder temperature safety interlocks, emergency stops and circuit breakers.

Two versions are available, the PT400 for boards up to 400mm (15.75") wide, and the PT460 for boards up to 460mm (18.1") wide.

For further information circle 249 on reader service coupon, or contact Roysston Electronics, 27 Normanby Road, Notting Hill 3168; phone (03) 543 5122.

Delta suppressor capacitors

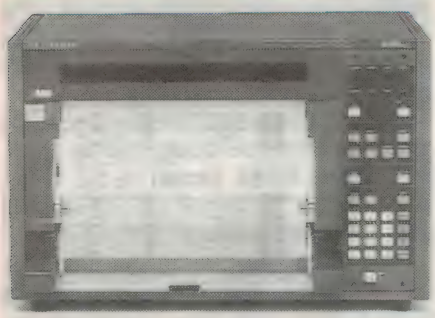
Rifa has extended its range of delta networks (one 'X2' plus two 'Y' capacitors in one convenient package), with the addition of the PZB300 series – specifically designed for PCB mounting.

Offering features such as a continuous rating of 275V AC, a temperature range of –40° to 100°C, high transient and dV/dt capability and a wide range of international approvals including VDE, UL478 and UL1283, the PZB300 is available in a choice of capacitance values.

Typical applications include domestic appliances, SMPS or as a component in a larger filter.

For further information circle 252 on reader service coupon or contact Ericsson Components, PO Box 95, Preston 3072; phone (03) 480 1211.

NEW PRODUCTS



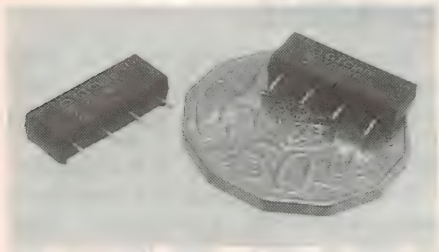
Multi-colour 32-channel recorder

ABB Goerz has announced the release of the new Multigor 480 intelligent 32-channel hybrid recorder. This modular and versatile recorder permits the user to adapt the instrument to their own special measuring tasks.

Up to 32 measuring values can be recorded in analog or alphanumeric form, using a low noise 8-colour ink jet system. The sampling time for all 32 channels is 1.5 seconds. Input types are selectable and include AC and DC current and voltages, most common thermocouples and resistance thermometer types.

Maths functions, alarms and optional interfaces with standard software further extend the potential applications for the Multigor 480. Panel mounted, rack mounted and bench top versions are available.

For further information circle 256 on reader service coupon or contact Kent Instruments, 70-78 Box Road, Caringbah 2229; phone (02) 525 2811.



Subminiature SIP reed delay

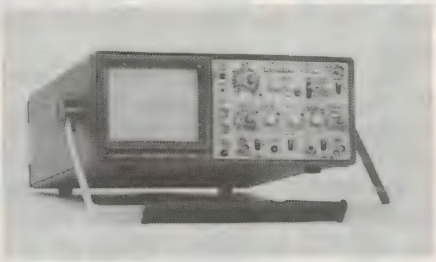
The DSS-4 SIP dry reed relay offers designers the superior switching characteristics of the Clare DYAD switch. The small package design of the DSS-4 requires less than 105 sq mm of board area, while the 5.08mm maximum width allows spacing of 6.35mm centres. Input power is as low as 50mW, which reduces supply requirements.

Construction of the DSS-4 features high isolation between input and output, exceeding 1500V AC RMS. The 5.08mm over surface area also provides both high impedance and high dielectric standoff voltages between these circuits.

The DSS-4 is available in four standard input voltages: 5, 12, 15 and 24V and has an internal diode option available.

The DYAD dry reed switch used in the DSS-4 features bifurcated, vacuum-deposited, nuthenium contacts, laser glass sealing and miniature size. It is rated at 250 million operations at low level loads (50mV). For higher level loads, it is rated up to 10VA. The switch also allows switching rates of 500Hz, as compared to 250Hz on competitive relays.

For further information circle 251 on reader service coupon or contact IRH Components, 32 Parramatta Road, Lidcombe 2141; phone (02) 748 4066.



50MHz delayed sweep oscilloscope

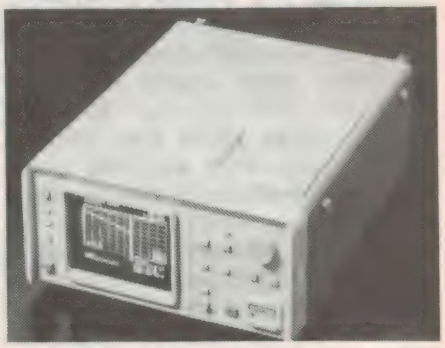
The Hitachi V523 is a 50MHz dual channel single timebase delayed sweep oscilloscope designed for ease of use in a wide variety of general purpose applications.

Measuring only 310 x 130 x 370mm and with a mass of 6.5kg, it lends itself to either field service or bench applications.

Single timebase delayed sweep gives expanded measurements of the (A) sweep from 1us to 100ms in five steps. Alternative magnification of CH1 allows a simpler method of waveform expansion, showing both a sweep and X10 magnified view. A leading edge delay line allows observation of the leading edge of a pulse waveform. A bright CRT display is achieved on the 6" CRT with a 12KV accelerator.

Vertical mode triggering allows CH1 and CH2 to have two different frequencies and lock both waveforms for a stable display. TV sync is achieved using a sync separator circuit, providing vertical stability not possible with a simple integration design.

For further information circle 250 on reader service coupon or contact IRH Components, PO Box 14, Lidcombe 2141; phone (02) 648 5455.



Optical time domain reflectometer

Anritsu's MW9010A is a compact measuring instrument for locating faults in optical fibres. It measures connection and transmission losses by launching optical pulses into the fibre, and receiving both the Fresnel reflection from breaks/discontinuities and returning back-scattered light.

The MW9010A measures only 132.5 x 284 x 350mm and weighs 9kg, making transport easy. Features including automatic fault location, with a loss threshold that can be set in 0.5dB steps from 1 to 5dB; batch averaging in all measurement ranges; 64 backup data memories; NEAR mode operation allowing fault detection by Fresnel reflection as close as 30m from the output connector; and the ability to drive an external plotter directly. A thermal printer is available as a built-in option.

For further information circle 241 on reader service coupon, or contact Alcatel Anritsu, 58 Queensbridge Street, South Melbourne 3205; phone (03) 615 6666.

Handheld 3.5, 4.5 digit DMMs

Meter International Corporation has released five new low cost high performance handheld digital multimeters.

The new instruments are intended for professional use in maintenance and test and service situations. They represent a careful mix of quality manufacture, very high accuracy, 33 functions – including a frequency counter ranging up to 200kHz – conductance measurement and audible continuity check.

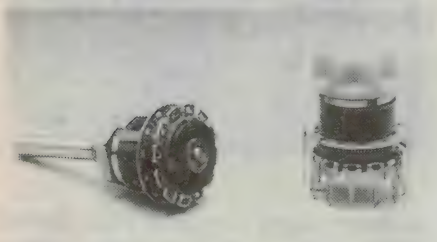
A detailed brochure describing all the models is available by circling 253 on reader service coupon or contacting Quiptek Australia, PO Box 335, Black Rock 3193; phone (03) 532 1328.

Miniature rotary switch

Erni's PS613 is a unique miniature rotary switch (12mm), dust and splashwater proof, even withstanding corrosive atmospheres.

It is suitable for any application in the field of telecommunications, measuring and control equipment and electronics.

The stainless steel spindle has a



diameter of 3mm and standard length is 20mm. The switches can be supplied with or without stops and employ high quality contact and insulation materials.

Other key features are 1 to 4 wafers with up to 8 contact bridges as well as 12 positions with indexing angle of 30° each or 6 positions of indexing angle of 60°. Special versions of the PS613 switches are also available for soldering directly into circuit boards.

For further information circle 255 on reader service coupon or contact Erni Australia, 12 Monomeeth Drive, Mitcham 3132; phone (03) 874 8566.

2.5GHz synthesised signal generator

The new model 5230A is the latest addition to Eaton's 5225A family of synthesisers. The 5230A is designed for the systems market or 'black box' applications – with no front panel controls, but with excellent performance capabilities. It operates over the frequency range from 10 to 2450MHz and offers ultra fast switching with exceptional spectral purity.

The 5230A's design incorporates a direct digital synthesiser for fast switching and phase lock loop circuitry for superior phase noise, spurious and harmonic performance. As a result its performance is claimed to be unmatched by any other commercially available synthesiser.

For more information circle 246 on reader service coupon, or phone Elmeasco Instruments on (02) 736 2888.

Pin grid array extraction tool

Energy Control International has released a pin grid array extraction tool, designed for the reliable extraction of expensive ASIC devices in 10 x 10 through 25 x 25 PGA patterns.

The thin wall construction of the tool requires a minimum of clearance from surrounding components, and the jack screw design coupled with four jaws which grip each side of the PGA socket allows for parallel extraction with a minimum of stress upon the component.

For further information circle 254 on reader service coupon or contact Energy Control International, 26 Boron Street, Sumner Park 4074; phone (07) 376 2955.

NEW PRODUCTS

Widerange optical power meter

Anritsu's newly developed ML9050A optical power meter is said to be the first of its kind to be used as a secondary standard for optical power measurement. It achieves optical power measurement with +/– 2% accuracy over a wide range of –10 to +10dBm for the first time in the world. Users can thus establish optical power traceability in their own facilities by using a conventional model, the ML9010A Optical Calorimeter, for the primary standard, and the ML9050A for the secondary standard.

The ML9050A adopts an optical absorber made of a chemically processed Ni-P (nickel-phosphorous alloy) compound that improves vibration and moisture resistance and reduces the reflection factor by half compared with conventional models using 'gold-black,' a gold particulate.

It is composed of an optical sensor and an indicator, and its easily mountable/dismountable connector adaptor can be used for either connector or beam input.

Further information from Alcatel STC, 58 Queensbridge Street, South Melbourne 3205 or phone (03) 615 6666.

Pocket TV pattern generator

A pocket television test pattern generator has been released in Australia by Peter Lacey. Designed for field or workshop use, the Sadelta MC11B offers technicians involved in the repair or installation of television equipment a source of colour bars, grey scale, and seven other useful test patterns in a very compact format.

The MC11B has an RF output that is tunable over bands III and IV, so both VHF and UHF are provided. The instrument comes complete with internal NiCad battery, charger/adaptor and a soft case. The suggested trade price is expected to be less than $500.

For details of your nearest stockist circle 270 on the reader service coupon or contact Peter C.Lacey Services, 74 Fulton Road, Mt Eliza 3930; phone (03) 787 2077.

Improved comms service monitor

The new IFR systems 1600S is a totally new design and concept in CSM technology. There is now a large colour CRT display combined with multiprocessor control, making the 1600S very easy to use. It has six different menu function screens; RF generator, receiver, duplex, spectrum analyser, oscilloscope and another for the various meter functions.

Standard features include a tracking generator, duplex generator with offset frequencies to 1GHz, digitised spectrum analyser, digitised 1MHz oscilloscope, bit error rate meter and multiprotocol data generator.

The RF signal generator covers from 250kHz to 1GHz in 100Hz steps and the output level is adjustable from –137 to 0dBm. The receiver also covers from 250kHz to 1GHz and will demodulate AM, SSB, FM and PM while monitoring frequency, frequency error, relative signal strength, RF power, modulation level and AF frequency. The receiver can also be programmed to execute user defined RF sweeps and scans for identification of unknown carriers.

For further information circle 268 on the reader service coupon or contact Vicom Australia, 4 Meaden Street, South Melbourne 3205; phone (03) 690 9399.

EA with ETI marketplace

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AMIDON FERROMAGNETIC CORES: For all transmitter and receiver applications. Send DL size SASE for data/price to: RJ & US Imports, PO Box 157, Mortdale, NSW 2223. Agencies at Geoff Wood Electronics, Sydney; Webb Electronics, Albury; Electronics Components ACT; Truscott's Electronics, Melbourne; S.Willis, Perth; Assoc TV Service.

CB RADIOS: $59 to $199, business, amateur, marine, outback, world-wide radios, scanners, power supplies, aerials, walkie talkies, amplifiers, test gear, microphones, HF, VHF, UHF, different gear weekly. We buy , sell, trade-in and repair. Enquire about hobby radio and computer club activities for beginners. Sam Voron, VK2BVS 24 hours, 7 day number, (02) 407 1066

WEATHER FAX PROGRAMS: For IBM XT/AT's*** "RADFAX2" is a high resolution, shortwave weather fax, morse & RTTY receiving program. Needs CGA, SSBhf radio & RADFAX decoder. Also "RF2HERC", "RF2EGA" & "RF2VGA"' same as RADFAX2 but suitable for Hercules, EGA, & VGA cards respectively. $35 *** "SATFAX" is a NOAA, Meteor & GMS weather satellite picture receiving program. Uses EGA or VGA modes. Needs EGA or VGA color monitor and card, + "WEATHER FAX" PC card. $45 *** All programs are on 5.25" OR 3.5" disks (state which) + documentation, add $3 postage . ONLY from M.Delahunty, 42 Villiers St, New Farm 4005, Qld. Ph (07) 358 2785.

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1 UL Willimson: and 1 mullard 20W Amp; 2 12 UX HI FI 2 Wharfdale super 3 speakers and x overs $300; Old valves transformers 500 VW Electros new.
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DISPLAY: 4 1/2 DIGIT
BASIC ACCURACY: 0.5% DC V
DC VOLTAGE: 0- 1000V
DC CURRENT: 0- 10A
AC VOLTAGE: 0- 750V
AC CURRENT: 0- 10A
RESISTANCE: 0- 20M OHMS
CONTINUITY TEST, DIODE TEST,
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USEFUL FOR TTL AND CMOS.
HIGH AND LOW INDICATORS.
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DC CURRENT: 0- 10A
AC VOLTAGE: 0- 750V
AC CURRENT: 0- 10A
RESISTANCE: 0- 20M OHMS
COMPACITANCE: 0- 20u[
TRANSISTOR hfe: GAIN OoF -2000oF
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DIGITAL MULTI METER HC- 3500T

DISPLAY: 3 1/2 DIGIT
BASIC ACCURACY: 0.5% DC
DC VOLTAGE: 0- 1000V
DC CURRENT: 0- 20A
AC VOLTAGE: 0- 750V
AC CURRENT: 0- 20A
RESISTANCE: 0- 20M OHMS
TEMPERATURE: - 20C- 1200C
CONTINUITY TEST, DIODE TEST
TEMPERATURE, CAPACITANCE
FREQUENCY, hfe TEST, DATA HOLD.

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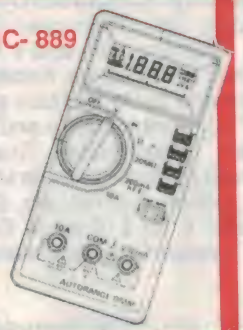
DIGITAL MULTI METER HC- 889

DISPLAY: 3 1/2 DIGIT
DC VOLTAGE: 0- 1000V
DC CURRENT: 0- 10A
AC VOLTAGE: 0- 750V
AC CURRENT: 0- 10A
RESISTANCE: 0- 20M OHMS
CONTINUITY TEST, DIODE TEST,
DATA HOLD, TR HFE GAIN,
AUTO RANGE DMM WITH BAR GRAPH.

SAVE $10



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ANALOGUE/DIGITAL MULTI METER

HC- 5050DB 3 1/2 DIGIT
BASIC ACCURACY: 0.5% DC
DC VOLTAGE: 0- 1000V
DC CURRENT: 0- 10A
AC VOLTAGE: 0- 750V
AC CURRENT: 0- 10A
RESISTANCE: 0- 20M OHMS
DC AC RMS: -45dB -+50dB
TEMPERATURE: - 20C- 1200C
AC FREQ SPREAD: 50Hz -2KHz
CONTINUITY TEST, DIODE TEST

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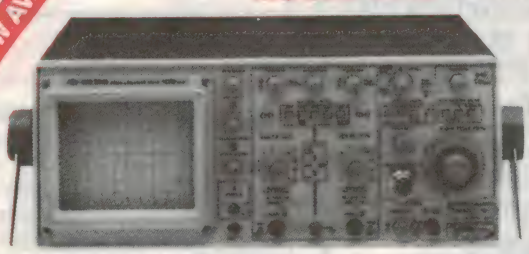
FOR MORE DETAILED SPECS PHONE (03) 543 7877

100MHz NOW AVAILABLE

100MHz 3 CHANNEL 8 TRACE MODEL 5510



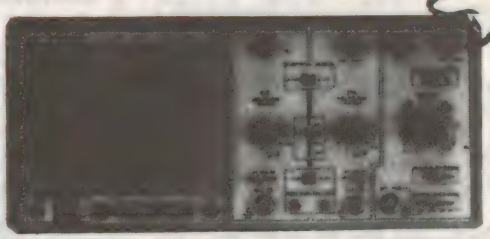
DC: DC TO 100MHz BANDWIDTH
AC: 10Hz TO 100MHz
CH1, CH2, CH3, ADD (CH1 + CH2)
ALT CHOP
A, ALT, B.B TRIG'D HORIZONTAL
OPERATING MODE

CRO Probe to suit $39.50 each - Cat. Q12201.

Q12109.....$2995.00

20 MHz DUAL TRACE MODEL 0S - 620

SAVE $35



CRT: 150MM RECTANGULAR
DC: DC TO 20MHz
AC: AC TO 20MHz
CH1, CH2, ADD, DUAL, AUTO AND NORM
TRIGGERED POSITIVE AND NEGATIVE
CONTINUOUSLY VARIABLE.

CRO Probe to suit $39.50 each - Cat. Q12201

Q12105.....RRP ~~$750~~ $715

GREAT SAVINGS GREAT SAVINGS GREAT SAVINGS

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MICROPHONES

FLOOR STAND WITH BOOM ARM
- Adjustable height
- Collapsible legs with rubber feet
- Boom arm with 3/8" and 5/8" male adaper.

H10494.....$99.95

PROFESSIONAL BASE STATION MIC
- Heavy duty low impendence mic with lock down switch
- Contains priority paging unit which overrides any background music

A10134.....$114.95

BALANCED MICROPHONE WITH "AKG" INSERT
- Top quality, low impedance dynamic microphone with heavy duty aluminium body.
- "AKG" insert is carefully mounted in a rubber anti shock holder
- On/Off switch mounted on body
- Fully sheilded 5 metre cord
- Microphone holder

A10140.....$124.95

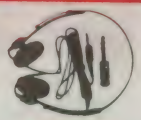
BALANCED MICROPHONE "PRIMO" INSERT
- Low impendance dynamic microphone fitted with a high quality "Primo" insert.
- Heavy duty matallic grey matt body.
- Cannon connector.
- Microphone holder.

A10130.....$89.95

BALANCED MICROPHONE "AUDIO TECHNICA" INSERT
- Heavy duty dynamic low impendance mic with an "Audio Technica" (ATUS)
- Matallic grey matt body
- On/Off switch, Cannon connector, Microphone holder

A10142.....$89.95

HEADPHONES



BUDGET MINI STEREO HEADPHONES
- Ultra light weight headphones with adjustable headband, soft foam earpads at an economical price.

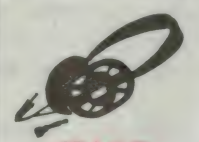
A14001.....$9.95

ENCLOSED STEREO HEADPHONES
- These headphones completely cover your ears keeping out unwanted background noise.

A14014.....$19.95

PARTIALLY ENCLOSED HEADPHONES
- These headphones have large soft ear cushions for comfortable positioning on your ears. They also have individual left and right channel volume controls.

A14005.....$34.95



CD & HI-FI HEADPHONES
- Designed for use with both digital and analogue recorded audio. Earpads fully cover your ears to keep out all unwanted background noises. Ideal for disc jockeys and other studio use.

A14015.....$49.95

TV/VIDEO MINI HEADPHONES
- Mono headphones specifically for use with TV sets or VCR's. The 1.5 metre lead from headphone is extended with a 5 metre lead which will allow viewing and private listening of your set up to 6.5 metres away. They also come with an inline volume control which lets you control the volume with without leaving your chair.

A14011.....$16.95

MINI STEREO INNER EARPHONES
- Diaphams fit directly into the ear for greater comfort and sound.
- Packaged in a protective storage case and comes with a spare set of foam earpads

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INDOOR ANTENNAS

UHF/VHF/FM INDOOR ANTENNA
- Radar dish designed 75 ohm coaxial cable antenna with separate UHF & VHF dipoles.
- Suits TV's, VCR's and tuners
- Built in UHF/VHF mixer.

L15039.....$39.95

TELESCOPIC ANTENNA
- 75 ohm coaxial cable antenna
- Suits & VCR's tuners
- Adjustable telescopic rods

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UHF/VHF/FM AMPLIFED INDOOR ANTENNA
- 75 ohm coaxial cable antenna with inbuilt 15db amplifier and separate UHF/VHF dipoles/receivers.
- Built in UHF/VHF mixer
- Frequency range : 40-890MHz
- VHF receiver: telescopic rods 910mm extended
- UHF receiver:4 elements with dirctional tuning

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- High gain 75 ohm coaxial cable antenna with separate UHF & VHF dipoles
- Built in UHF/VHF mixer
- Frequency range 40-890MHz

L15033.....$24.95

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- 300 ohm ribbon cable antenna
- Suits AM/FM tuners and portable TV's.
- 1 metre lead with 300 ohm spade terminals

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- 75 ohm coaxial cable antenna with separate UHF and VHF dipoles / receivers.
- Built in UHF/VHF mixer
- Frequency range: 40-890MHz

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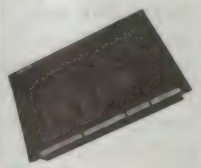
MIXERS

FIVE CHANNEL STEREO AUDIO MIXER
- Compact portable mixer with independant bass and treble controls and 2 power analogue output VU meters.
- 1 x low impedance microphone input
- 2 x stereo magnetic turntable inputs
- 2 x stereo line inputs
- Output sockets for both amplifer and tape deck.

A12013.....$249.95



FOUR CHANNEL STEREO AUDIO MIXER
- Compact portable desk mount or panel mounting stereo mixer with 5 band graphic equalizer and twin LED display VU meters.
- 1 x low impendance microphone input switchable
- 3 x stereo magnetic turntable inputs switchable
- 3 x stereo line inputs-switchable
- Headphone monitoring on all channels
- 18 dB talk over switch
- Output sockets for both the amplifier and tape deck

A12012.....$399.95

PLUG PACKS

300 mA PLUG PACK
- 240 volt AC input to switchable DC output
- 1.8 metre cord with interchangable pluge
- Polarity reversable pluge and sockets
- Supplied with 1/1.3/2.1/2.5mm Dc and 2.5/3mm phone pluge

M19004.....$23.95

500 mA POWER PACK
- 240 Volt AC input to 500mA DC output
- 1.6 metre cord with unique plug system
- Polarity reversable socket
- 2.5/3.5 phone & 2.1/2.5mm DC pluge supplied.

M19005.....$23.95

6/9/12 VOLT DC 500MA PLUG PACK
- 240 V AC input to regulated 6/9/12 volt DC output.
- Specially designed for Walkmans & portable audio
- Intergrated circuitry prevents audio system hum.
- 1.8 metre cord with interchangable plug system.

M19009.....$39.95

13.8 VOLT DC 800MA PLUG PACK
240 V AC input to 13.8 V DC output
- Designed specifically for alarm panels
- 1.8 metres with bared ends.

M19040.....$34.95

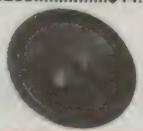
12 VOLT DC 2000MA (2AMP) POWER PACK
- 240 V AC input to regulated 12 V DC output
- Ideal for high current drain applications where large amounts of power are required
- Outputs: Screw terminals or 4mm banana sockets

M19030.....$79.95

SPEAKERS

8" DOPED PAPER CONE
- High compliance rubber surround.
- Dark grey cone
- Black dust cap
- Black round frame

C10233.....$44.95



10" HIGH POWER WOOFER
- With ribbed black paper cone
- Black dust cap
- Cloth edge
- Rubber mounting seal

C10228.....$49.95

10" DOPED PAPER CONE
- High compliance rubber surround.
- Dark grey cone
- Black dust cap
- Black round frame

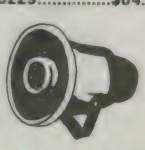
C10238.....$59.95

8" FULLRANGE
- Twin cone speaker with white paper cone ideal for public address column speakers .
- Foam edge
- Whizzer cone

C10224.....$24.95

12" HIGH POWER WOOFER
- With ribbed black paper cone
- Black dust cap
- Cloth edge
- Rubber mounting seal

C10229.....$64.95



6" HORN & LINE X'FORMER
- Weatherproof plastic horn with 100 volt line transformer.
- Adjustable metal bracket

C10218.....$74.95

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		$500 plus	FREE

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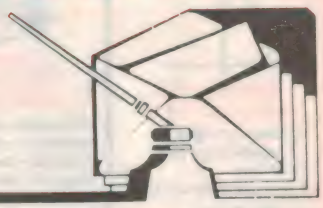


Conducted by Peter Phillips

The project dilemma

This month we look at why some project ideas never get developed and discuss a few that have been. The What?? question stems from a project yet to appear, while some interesting technical questions are provided for all to ponder.

A magazine such as *EA* faces the difficult task of trying to provide a publication attractive to a wide range of readers. If we're successful, we keep our jobs and the institution known as *Electronics Australia* remains alive. If not, well... Projects form a major part of the magazine and represent our single greatest investment in time and effort. Feature articles come a close second, although these are usually much less demanding to write and produce.

A project starts out as an idea, which then has to be brought to reality by a prototype. Once working, the final design needs to be perfected and fully checked. Then comes the article to describe it, along with the attendant drawings and photos of the project. The process of developing the prototype takes the longest time, and periods of six months are not uncommon, particularly when a complex PCB is also required.

Yes, you know this already, so what is my point? A particular problem is providing projects that are both useful and cheaper than commercial equivalents. Also we need to keep in mind the resources of our readers, such as the inability for most people to produce a double-sided PCB. My point is that many projects that were attractive even 12 months ago are no longer viable as a build-it-yourself item.

Imagine the interest level if we described how to build a portable radio. These days AM/FM radios are given away with $20 worth of petrol, and the only people who would be interested would be those keen to learn about radio in a practical sense. In other words, technology has brought the price of many electronic items to virtually rock bottom, and very often a project is a more expensive way of obtaining the item.

We get numerous letters from time to time requesting that we develop a particular project, and in many cases we have to acknowledge that our (and your) resources are likely to be inadequate. In other cases it is obvious that we could not match the quality or low cost of a commercial model. Who'd bother designing an XT compatible IBM computer, or even the TV monitor when these can be picked up almost as disposal items. Ham radio operators are now well catered for commercially, and even test instruments are becoming difficult to make into viable projects.

Times have changed dramatically, and our projects need to reflect current conditions. We rely on readers sending us suggestions, as this is a major form of feedback. Electronic component retailers keep us informed of project popularity and sometimes even supply us with projects of their own design. Their hope is that the cost of developing the device will be met (and exceeded) by kit sales.

It's a difficult area and a challenge we believe we are meeting. Our aim is to present at least three projects each month, hopefully four. When you consider that these have to be simple enough for home construction, useful, innovative and cheaper than a commercial equivalent, then you can imagine the problems. Yes, 40 or more such projects each year, every year – a challenge that is both interesting and exciting.

Our first letter this month follows on from my discussion, and is typical of many similar requests.

Car booster amp

We were all very impressed with the Pro Series One power amplifier, a brilliant project. Something else we have all been waiting for is a high quality power amplifier and dividing network for a car. Maybe this could be kept in mind for an upcoming project. (J.I., Tintenbar NSW)

Thanks for the comments on the Pro Series Amp, J.I.; we like it too! Your letter is not the first requesting a booster amplifier for a car and we have spent some time considering it as a project. A 100W car stereo amplifier was presented in August 1985 and was probably built by quite a few constructors.

These days a commercial car booster amplifier can be quite expensive, although if you shop around it is possible to find them for less than $200. Certainly there is a degree of hype that allows certain 'name' brands to charge $500 or more, on the grounds of compatibility with existing equipment. I recently challenged a salesperson trying to justify such a price and came to the conclusion that a $200, non-compatible unit could be used by adding a simple voltage divider to attenuate the output of the radio-cassette.

The main difficulty with a car booster amp is the design of the DC-DC converter required to produce the supply rails, as the amplifier itself is generally fairly standard. But when you start adding remote switch-on, a smart looking case and all the other enhancements available in commercial models, it becomes even more difficult, particularly when we are restricted to using off the shelf components.

However this is a project we are still

considering, although I wouldn't like to say it will happen quickly, or guarantee it will happen at all.

TV remote controls

On the subject of suggested projects, the next writer is one we *can* assist:

What about an article describing the operation of remote control units for TV sets and VCRs? The remote control unit for my Sanyo TV set recently started to play up and I fixed it by rewiring it to use spare buttons. Other buttons are now not working and a new unit will cost $125. Perhaps you could describe a tester for a remote control, as I have other remote units that I may be able to modify instead of spending $125 on a new one. (M.B., Toukley NSW).

By now M.B., you've probably noticed our IR remote control tester published in the September 1990 edition. This project was developed by Oatley Electronics and I wrote the article describing the project. A description of the operation of a typical IR remote control was included, with someone like yourself in mind.

Modifying another remote control unit may be difficult, as the bit pattern for each code is the main problem, rather than the frequency of the transmission. Instead it may be more feasible, if a bit tricky, to marry a good keyboard to the electronics of your Sanyo remote control unit. The pushbutton assembly is usually the section that fails and I have to admit to only limited success in repairing these. The carbonised surface of the button wears out, buttons break and so on – all sorts of physical failures, rather than an electrical fault.

Because all remote units seem to use a different technique for implementing the pushbuttons it is not possible to describe a general way of fixing these, but at least our article may assist.

Pro Series 1 amp

The writer of the following letter wants clarification about the power output specification of the December 1989 Pro Series One amplifier:

I have been studying the circuit diagram of your Playmaster Pro Series amplifier, and am at a total loss at how you are able to obtain 100W RMS per channel.

As I see it, the MOSFETs, Q9-12 are connected in a common drain configuration and have a gain of less than unity. Since the peak gate voltage is limited to about 12.7V by ZD1 and D1, the maximum theoretical output power across an 8 ohm load would be $12.7^2/1.41$ all divided by 8, giving 10W RMS.

I would be grateful if you would explain the operation of the power output stage in Information Centre. (P.G., O'Connor ACT).

Fair enough P.G., good question and one that Rob Evans didn't fully address in the text describing the amplifier.

The answer is fairly simple, but first let's consider the required peak to peak output voltage to get 100W RMS in an 8 ohm load. I use the equation $(Vp\text{-}p)^2/8Rload$ to calculate this, and by my calculations a peak to peak swing of 80V is required. That is, the voltage at the output must swing from –40V to +40V, requiring at least this amount of swing at the gates of the MOSFETs.

If +40V is present at the gates of the MOSFETs, the N channel pair will turn on (Q9-10) and the P channel pair turn off. The output line connects to the source terminals of all four MOSFETs and this will rise to virtually +40V by source follower action. Note that neither of the diode/zener diode pairs are biased on as the potential difference across both is around 0V.

Similarly, when –40V is present at the gates of the MOSFETs, the output line will also be –40V, again having no effect on the diode/zener diode pairs.

In fact, the only time conduction can occur in either of the diode/zener diode networks is when a fault condition at the output (short-circuit or similar) causes the gates of the MOSFETs to be different from the output voltage by more than 12.7V.

The point missed by P.G. is that the voltage at the output always follows the collector voltage of Q8 (and Q6), and it is only when a fault occurs that the diode/zener diode pairs start conducting. Their role is to protect the MOSFETs, which don't take kindly to being forward biased by more than a reasonable amount. If the protection networks were not present, a short at the output could give a differential of up to 69V between the gate-source terminals, with the immediate demise of the MOSFETs.

VCR Jitter

The Serviceman is one of our most popular features, and the next letter is prompted by the story described in May 1990:

I have a Kreisler TV similar to that described by the Serviceman in May 1990, although the model of my set is 660-10. Like the one described, all faults in my TV have been due to dry joints.

But my problem concerns playing prerecorded videos on my VCR through the Kreisler. The top of the screen flickers, although it is not too bad on videos recorded off air. Is there a standard remedy for this problem? (B.S., Aranda ACT).

This problem was common with TV sets manufactured around the time of your Kreisler. I had a similar problem with my Pye T29 many years ago, and the required modifications to overcome it were described by Pye (actually Philips) in one of their technical publications.

The problem is due to the synchronising signal from the VCR, which is slightly different to that from an off-air signal. Some TV sets have a channel set aside for a VCR, and include extra processing to overcome this problem. In your case, there is no doubt a modification available, usually in the form of a few extra components around either the sync separator or horizontal sync section.

Perhaps a reader may know the modification and be kind enough to send us a copy, as it has been some years since I last played serviceman. Failing that, a letter to Philips may elicit a reply, as they bought out the Kreisler operation many years ago.

Capacitor dilemma

The next question is one I'm not sure I can answer, though I'll try...

At Tech several years ago, I remember my teacher mentioning that electrolytic capacitors do not develop anywhere near their labelled value (plus tolerance) until they are within two thirds or so of their rated operating voltage.

This thought came racing back as my flatmate and I took turns at constructing EA's Playmaster Tuner of December 1985. We purchased a kit and noticed that some of the electrolytics had voltage ratings up to six times that specified in the article – the small (less than 10uF) types in particular.

I mentioned this to the store staff, who held that 'caps is caps.' I would tend to believe them, but if any rating will do, why don't manufacturers simply produce 100V electrolytics and not bother with the smaller voltage ratings? Physical size makes little difference these days and there seems no benefit for manufacturers, wholesalers, retailers and the buying public to produce a range of voltage ratings if one would do.

Despite having telephonically travelled the city, I am yet to find someone who

can supply me with 1uF/16V RB electrolytics. Did they exist when the project was designed? Is it important? Will tantalums suffice, or do they suffer from the same alleged problem?

I hope you can help with this one, as we are eager to get the famed tuner up and running. (G.S., Ashfield NSW).

Something lingers in my mind that the dielectric in an electrolytic capacitor is properly formed only when the capacitor is operated at something around its rated working voltage. But practical experience suggests this is not so.

If it were, then measuring the capacitance of an electrolytic capacitor on a typical capacitance meter would give values to demonstrate the phenomenon, as the DC potential from most measuring instruments is usually very small. I have used all kinds of electrolytics in critical applications, and apart from leakage considerations, have never bothered about the working voltage rating except to ensure it is adequate.

It could be that the teacher was remembering the bad old times when this may have been a problem, but today's capacitors certainly don't seem to change capacitance with the working voltage. Your comment about the needless range of working voltages for electrolytics seems fair enough, G.S., though I suspect physical size is still the reason.

I think, though I cannot be certain, that if we could examine the current range of electrolytics from a given manufacturer, we would find the physical size for a particular capacitance value would increase with the working voltage. On the other hand, it may also be that manufacturers opt for a certain size and reduce the current rating when the working voltage is increased.

But to be honest, I don't really know, except to say I always choose a physical size for a capacitor commensurate with the current I anticipate it will need to handle. So, in my opinion you and your mate can happily proceed with the 'famed' tuner, and use the supplied components. A tantalum type can be substituted for a low leakage electrolytic, although it will usually be more expensive.

If someone can offer more on this topic, I would be pleased to print their comments – as I would like to know the answer as well!

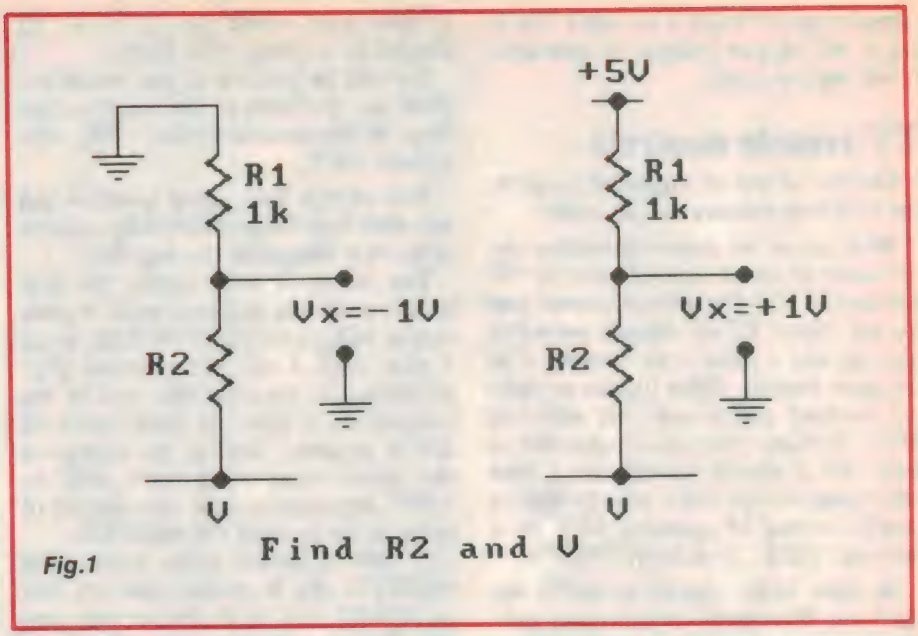


Fig.1

What??

I recently needed to design an op-amp Schmitt trigger, with a hysteresis voltage of 2V centered around 0V. Assuming the output voltages of the op-amp are either 0V or +5V and that one resistor (R1) is 1k, calculate the value of the other resistor (R2) and the reference voltage (V). The circuits describing the problem are shown in Fig.1. Fancy maths are not allowed (but Ohm's law is OK) and you have 20 minutes.

Answer to last month's What??

The trick with last month's What?? question is to realise that the series diode creates a different waveform at point A to that at point B. At point A, the waveform is a series of positive half cycles of the input sine wave, while that at point B is a straight line equal to the peak of the waveform at A.

Because the DC (average) value of the waveform at point A is 100V, its peak value needs to be determined to find the voltage at point B. The average value of half a sinewave is found by dividing its peak value by 0.637 ($2/\pi$), so conversely the peak value equals 1.57 times its average value (or Vpk/0.637). This gives 157V as the peak value of the waveform at A, so assuming no losses, the voltage at point B is 157V DC.

Working backwards from this to find the RMS value of the input voltage gives 111.3V, found by dividing the peak value by 1.41 (square root of 2). As a check, the average voltage of a series of positive half cycles can also be found by multiplying the RMS value of the input by 0.9, and sure enough, 0.9 x 111.3 gives 100V.

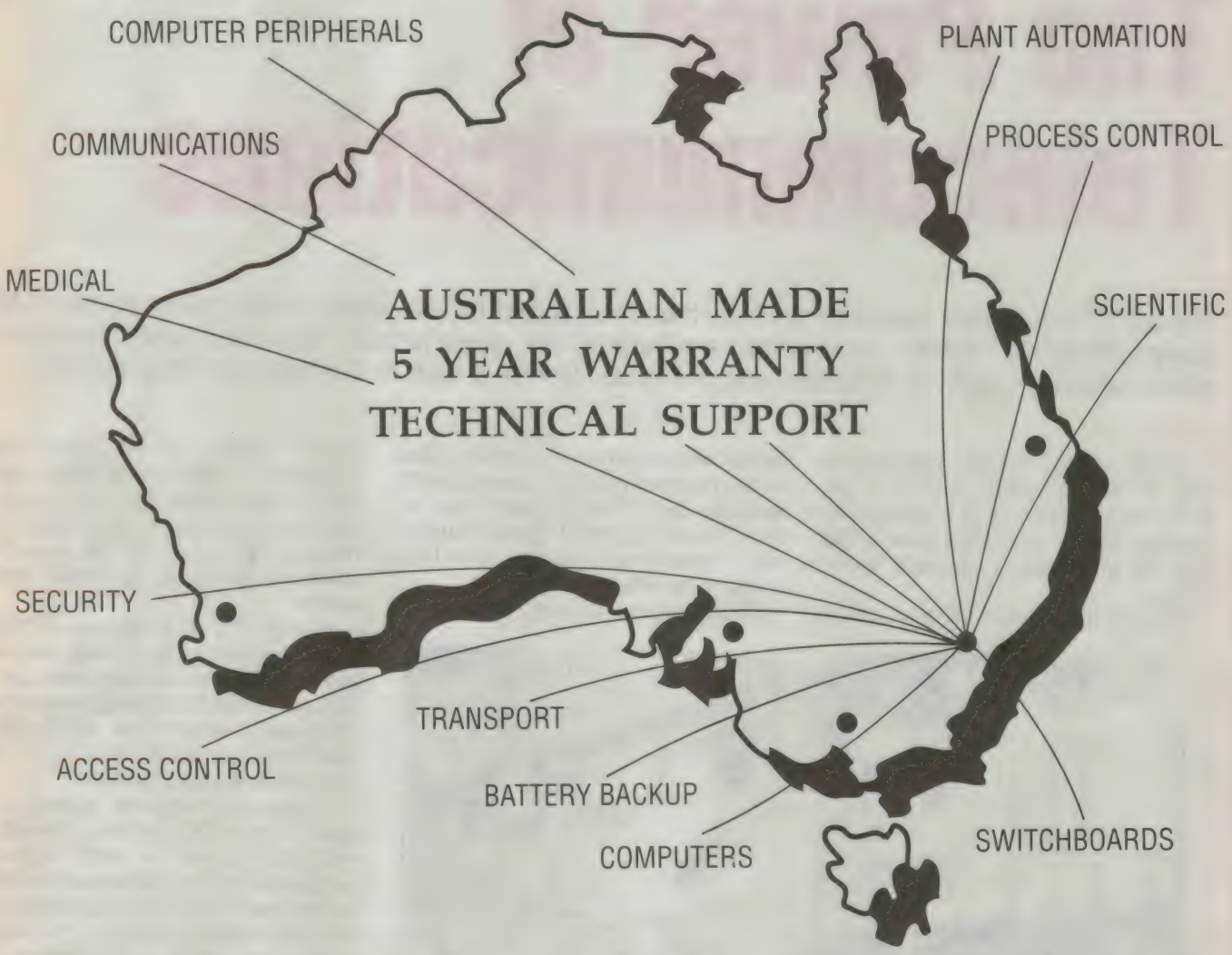
NOTES & ERRATA

POOR MAN'S VARIAC (Circuit & Design Ideas, September 1990): Due to a drafting error, the schematic shows the rotor for switch SW1a in the wrong position; it should be shown in contact with the third contact from the top mirroring the position of the rotor of SW1b. Both ganged rotors move 'up and down' together, in other words. The ganging system shown would result in a constant 240V output, defeating the object of the exercise – which is to add or subtract voltages from the secondary winding, to achieve a variable output.

IR-FM GATEWAY MONITOR ALARM September 1990: Somewhere in the mountain of trees (paper is made from trees) in the *EA* office there is a letter with the address of the author of this article. Unfortunately, the letter cannot be located. As we like to make sure our contributors feel appreciated, payment is made as soon as possible after publication. In this case, payment cannot be made until the address is found or the author contacts us. So please, Mr. Gregory, when you read this, please contact Jim Rowe as soon as you can.

VK POWERMATE 25 (January 1990): The component overlay on page 87 shows D2 connected the wrong way around. The cathode (indicated by the black stripe) should face to the left and connect to D1 and C12, as shown in the schematic diagram (page 85).

AUSTRALIA – WE'VE GOT YOU POWERED!



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Power Supplies Feature:

The Power of Telecommunications

Alcatel STC's Power Systems division has specialised for 40 years in the manufacture of telecommunications power conversion equipment for government, industrial and commercial organisations – both in Australia and overseas. Here's a look at the products they make...

Power supplies are the unglamorous end of the electronics market – the heavy-duty workhorses in a spectactular industry replete with show-ponies. But they are an essential component, nevertheless.

Who hasn't experienced that sinking feeling when a personal computer, filled to the brim with a day's unsaved work, suddenly dies? Nothing raises your interest in uninterruptible power supplies (UPS) more than a couple of brief flickerings of the office lights.

On the macro scale, the telecommunications systems of our society can't function too well without power either. This is technical territory where some of the most interesting work is being done on large UPS's, and it is one area where Australia holds a significant export market.

Testing a Buck Boost rectifier unit at Alcatel STC's Liverpool plant. The unit shown is part of an export order destined for Hong Kong.

Alcatel STC at Liverpool in Sydney supplies a wide range of large and small power systems to the telephone companies of Asia and the Pacific region. And telephone companies are highly critical purchasers of power systems – they expect and demand the best.

In general, telephone exchanges require 48 volt DC supplies, although 24 volts DC is used in some radio-type equipment, mainly microwave and cellular systems. The 48 volts classification is only the nominal voltage – the technicians often set-up their exchange to about 52 volts – so it is understood in the power supply industry that the supply voltage should be settable between 45 and 60 volts.

Current requirements are variable too. The big metropolitan telephone exchanges might use 4000 amps, while a very small rural exchange might only have a single 25 amp unit. For this reason, the tendency in recent years has been to design modular units which can be stacked to provide whatever range of power outputs are required.

This is the thrust of all recent research and development work in this area; with modularity, increasing power capacity is easy if the exchange load increases. The modular approach also provides redundancy in the case of a single unit failure.

Telecom Australia has traditionally depended on the relatively conventional

'float rectifier' system, where the batteries and the load are simply paralleled across the rectifier's output terminals. In the wide world we might refer to these as constant-trickle battery chargers, although they are expected to maintain the power independent of the batteries.

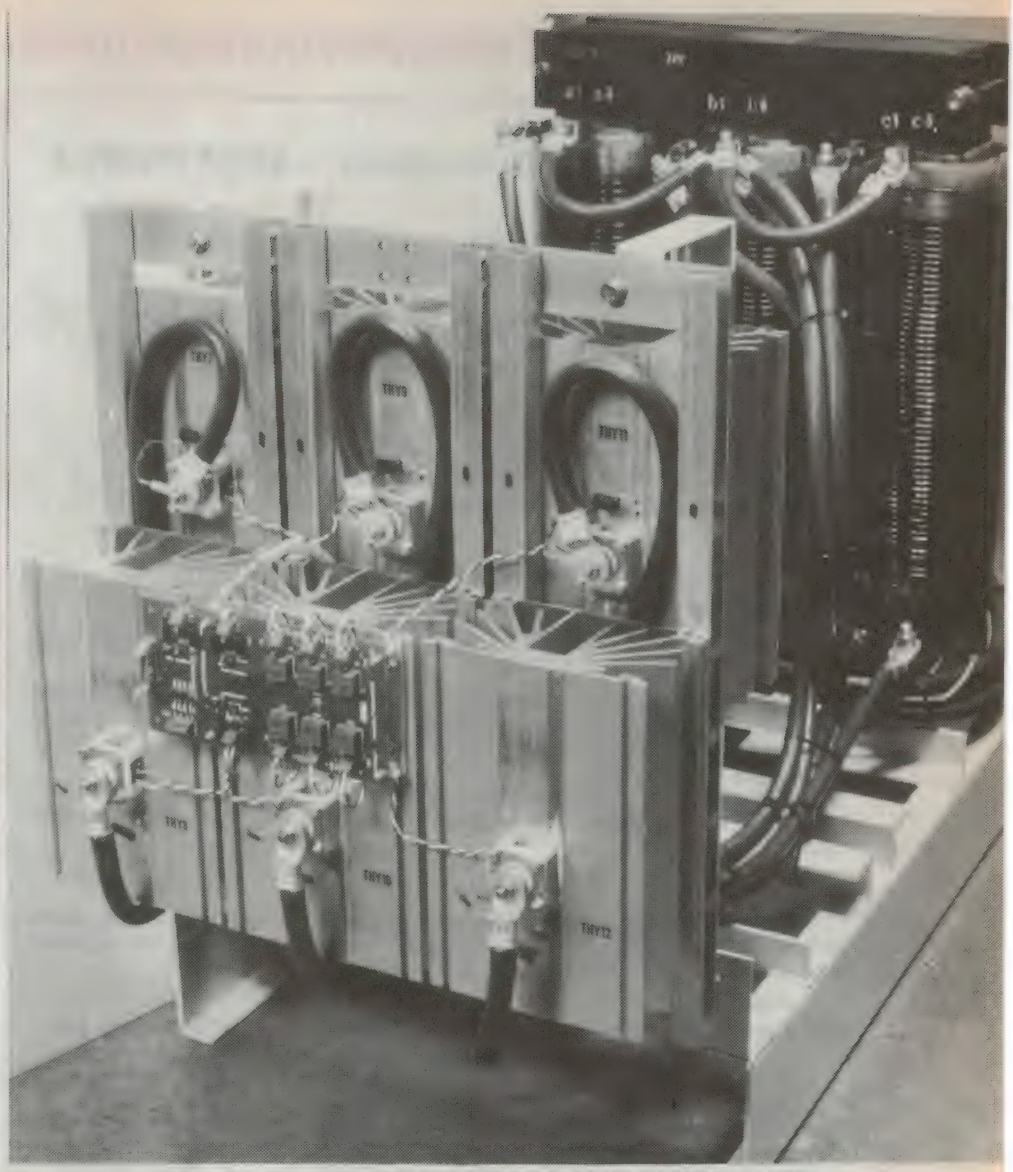
Another popular type of exchange power supply, and one that has given Alcatel STC consistent sales to Asia, is the 'Buck-boost'. This creates a supply voltage which is in series with the exchange battery, and since the polarity of that power supply can be either way – it can add to ('boost') or subtract from ('buck') the battery voltage – this provides flexibility to the exchange. The technicians can choose the voltage they need and are not controlled by the battery output alone.

The buck-boost technology has been around now for many years, but at the time it was being widely used, it was a significant money saver. Buck-boost systems ran at a lower voltage and used less power, and the fine control mechanism was important because the earlier exchange equipment had very tight voltage constraints. What was even more important was that this buck-boost approach produced a very fault-tolerant power supply – even with two or three faults, it could still achieve a regulated supply.

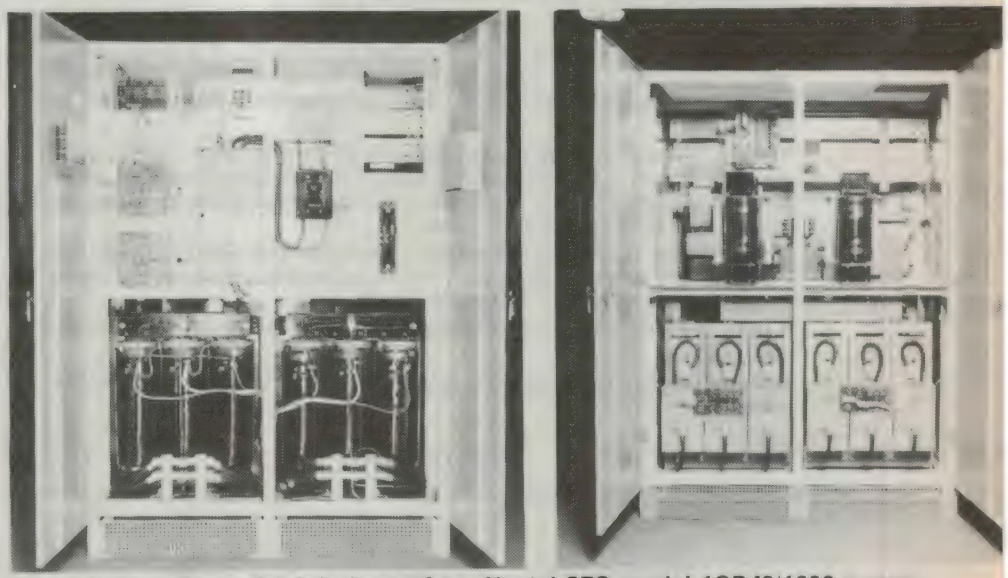
The term 'Uninterruptible Power Supply' is now more often applied to inverter systems which provide an AC output, but buck-boost and similar Telecom supplies are all UPS's in the sense that there is enough battery power to supply the equipment for between 15 minutes and an hour in the event of power failure. They use either the conventional lead-acid 'vented' batteries, or the later 'sealed' type. In addition to battery storage, virtually all Telecom exchanges have a diesel generator which will pick up the load after a few minutes and power the exchange indefinitely.

Currently the R&D emphasis is on switch-mode power supply (SMPS) systems, and Alcatel STC is developing this technology as the way of the future. The real practical difference is the reduced physical size of SMPS systems. When Telecom ultimately go all switched-mode, they will have a range of module sizes possible ranging from 4 amp to 200 amps, and if they wish they can have a large number of 4 amp units linked into a distributed power network within the exchange.

The essential ingredient in SMPS systems is that they use high-frequency switching. These units are more akin to



A power module with three-phase transformer and six thyristor rectifiers.



Front (left) and rear (right) views of an Alcatel STC model 1CD48/1600 power rectifier, using two modules as shown above. Each double-rack rectifier produces up to 1600A at 48V, and they can be paralleled for higher output.

ALCATEL STC POWER SYSTEMS – BRIEF PROFILE

PRODUCTS

Manufactured locally:

Large Rectifiers, 48V and 24V. Rated at 200, 400, 800 and 1600 amps, with DC Switch Distribution Cubicles. Small Rectifiers, 48V and 24V. Modular types in racks, rated 25 amps per rectifier module. Five per rack to give 100/125 amps.

Imported:

Uninterrupted Power Systems (UPS). Rated from 10, 20 and 40kVA (single phase) and from 15 to 250kVA (three phase). Imported from SICA (Societa Italiana Conersione Energie), Italy. Sealed lead-acid batteries from 15 through to 400 ampere-hours. Imported from Alcatel member-company, CEAC/FULMEN of France.

MANUFACTURING FACILITIES (Liverpool, NSW)

The total development and design of power system equipment, rectifier assemblies, transformers, cubicles and printed circuit boards is undertaken by company engineers and draughtpersons using the most advanced CAD systems.

Manufacturing processes include sheet metal cubicle fabrication on CAD/CAM (Computer aided design/computer aided manufacturing) machinery, powder coating line for painting, transformer winding, and PCB assembly, sub-assembly, main assembly and testing.

Quality control procedures are implemented throughout the manufacturing processes. At the final stage, prior to delivery, customer inspection may also take place.

MARKETS

The major market for power conversion equipment is the telecommunications industry in Australia and overseas. In 1989, Power Systems sales will approach A$11 million. Some 30% of this total is due to export.

Australia:

Telecom Australia is Power Systems largest customer. Other markets include the various municipal and state electricity authorities that use rectifiers, batteries and battery chargers to secure power supplies in power stations and control centres.

UPS are mainly used for computer back-up, to ensure reliability of clean power irrespective of the quality of the normal commercial power source. UPS customers include banks and government offices, as well as industrial and commercial enterprises.

Overseas:

Hong Kong: The Hong Kong Telephone Company is a long established customer, using Alcatel STC Buck Boost Rectifiers in its telephone exchanges. A $3 million, three year contract was received in late 1985.

Taiwan: In 1988 a contract was secured to provide large battery chargers for power station use by the Taiwan Power Company. This initial order is expected to lead to additional sales. Taiwan plans to double its power capacity in the next ten years.

China: Three Buck Boost Rectifiers have been sold into China via the Hong Kong Telephone Company. With one rectifier previously in place, two additional units were delivered in 1988.

Papua New Guinea: Large rectifiers were sold to Papua New Guinea during 1988.

Malaysia: Large rectifiers were sold to Malaysia at the beginning of the 1980s.

EMPLOYMENT

Power Systems employs 86 people, as follows:

Marketing		6
Engineering		13
Manufacturing	Indirect	9
	Direct	54
	Apprentices	4

a high-power transmitter than to conventional power supplies, which did their conversion at 50Hz. The AC mains power was converted to DC directly from the 50Hz mains and the isolation/coupling was through very large iron transformers.

The new technologies use frequencies in the order of several hundred kHz which are created within the power supply. Alcatel's approach is to rectify the AC directly from the mains to create a high voltage DC, and then use this to drive some sort of switching circuit to produce a high frequency square-wave.

Switched square-waves are very efficient because the current is either entirely off, or entirely on – but this 'pseudo' AC can still be used to drive a relatively small ferrite transformer (for isolation and voltage transformation) and another full-wave rectifier to produce the required output of 48 volt DC.

"The value of this approach is that it produces a power supply that is smaller and cheaper, and can be rack mounted and stacked," explains Wayne Badger of Alcatel STC's Power Systems division. "All components can be reduced in size when you are dealing with higher frequencies rather than 50Hz, and you achieve very high efficiencies. We aim for 90% efficiency or more, and we think that we can possibly achieve much higher figures in the future."

The use of high transformer frequencies also introduces a possible problem with electro-magnetic noise (both conducted and radiated), but with good design and electrostatic screening Alcatel says its new units can be placed in close proximity to the most sensitive analog or digital communications equipment, and that they also provide very high isolation of the DC output from any AC-mains common-mode noise. Additionally, an RFI suppression filter network is fitted to the control cable connections, and AC and DC protection is provided by circuit breakers.

The control systems use an opto-coupler for isolation, and they provide AC 'under and over' voltage protection, DC over-voltage protection, current limiting, boost-float facilities and automatic shut-down. An alarm system provides local and remote indicators.

Alcatel STC's Power Systems division is well advanced in researching new techniques. The present approach to power conversion relies on silicon diodes and thyristors (Silicon Controlled Rectifiers, or SRCs), but in future years Badger says that these devices will be replaced by field effect transistors (FETs).

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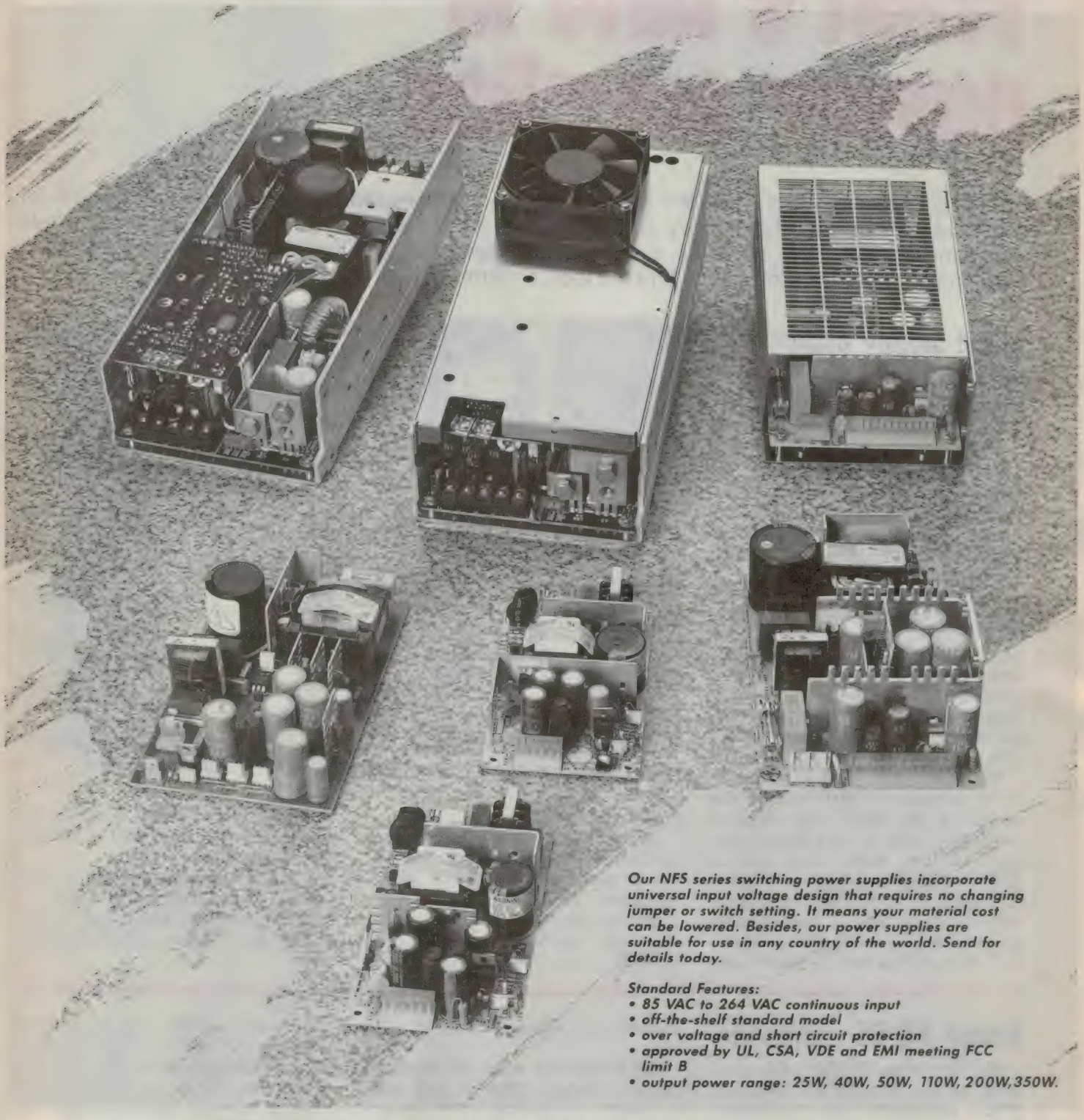

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Power Supplies Feature:

What's new in power supplies

Power supplies may not have the same glamour of other areas in electronics, but they're an essential part of just about every piece of electronic equipment. And as that equipment gets ever smaller and more powerful, power supply designers are having to make their products both smaller and more efficient. Here's a look at some of their latest achievements.

Local supply maker wins AS3901/ISO9001 quality accreditation

Melbourne-based designer and manufacturer of power supplies Setec has gained official accreditation for its performance in quality control systems, joining the ranks of a handful of Australian electronics companies to gain such recognition.

The Standards Association of Australia (SAA) has recognised Setec under AS3901/ISO9001 for their quality assurance in design, development, production, installation and servicing. This is a considerable achievement, because Setec is the first Australian power supply manufacturer to gain such recognition.

This standard is identical to international standard ISO9001 and is thus recognised the world over. National standards bodies in most major countries of the world have adopted ISO9001 and given it their own number. Accreditation to AS3901 shows proof that a company has an internationally accepted quality management system and, as such, becomes a 'Quality Endorsed' company.

Setec's managing director Peter Lloyd with the firm's SAA endorsement.

"We expect to win more customers as a result of becoming a Quality Endorsed company," said Setec's managing director, Peter Lloyd.

"We are also one of very, very few Australian electronics companies to have our products approved to international safety and EMI standards by overseas agencies such as UL, CSA and TUV," he said.

A delegation from the British Approvals Board, Telecom (BABT) recently visited Setec and Lloyd expects to gain approval from them in the near future.

2-watt DC/DC converter

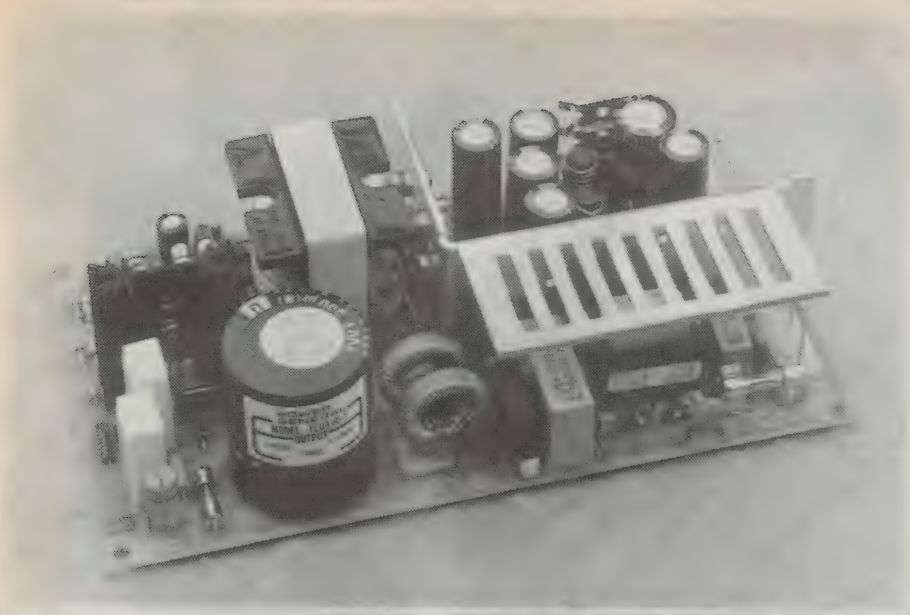
The Burr-Brown PWR-60XX series of power supplies offer low cost, low noise devices suitable for numerous applications.

Housed in a non-conductive industry-standard package, the series are available with single or dual outputs with voltages from five to +/–15 volts. The nominal input voltage is 5, 12, 15 or 24 volts.

The PWR-60XX series are regulated supplies and have filters on both input and output. Thermal shutdown protection is an integral feature with these power supplies. A 1KV high voltage isolation option is available. They require no external components to function.

The series includes nine models, all set in hard-cast epoxy resin for excellent thermal dissipation for the internal SMT components. All of the above features result in superior reliability with long predicted MTTF.

For further information circle 211 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011.



Universal input 65W switcher

Power General's FLU3-65 series is a family of highly reliable triple output 65 watt switching power supplies. Four models provide output combinations of 5, 12 and 24V DC. All models are approved for international safety standards including, UL, CSA and TUV (VDE).

High performance features of the FLU3-65 series include a universal input voltage range of 85V to 265V AC (100V to 370V DC). Universal inputs allow equipment manufacturers with international markets to specify and stock one power supply (they also eliminate field system failures caused by the incorrect wiring of the power supply input). An onboard, input line filter exceeds the requirements of VDE/FCC Class 'B' by an average margin of 10dB, virtually eliminating noise due to conducted emissions (and in many cases eliminating the need for an external line filter).

Other features include 0% minimum load on auxiliary outputs (< on the primary output, indefinite short circuit protection, soft start, overvoltage protection and a hold-up time of 16 milliseconds. The minimum MTBF is 175,000 hours. MTBF is calculated using the stringent MIL-STD 217E " parts stress" method. This high level of reliability is achieved by applying very conservative design practices to component selection, layout and derating.

For more information, circle 213 on the reader service coupon or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Silver oxide, lithium cells

Long established West German battery maker Varta Batterie AG, one of the largest suppliers of batteries for both OEM and consumer use, has developed a silver oxide alkaline 'C' cell with a capacity of 3.4 ampere-hours and capable of operating at +195°C. The cell is intended for specialised industrial applications, such as powering measurement and data logging equipment for drilling rigs.

The cell produces a nominal 1.5V and has a suggested current range of from 0 to 400mA. It uses a zinc and silver oxide system with potassium hydroxide electrolyte. Rated operating temperature range is from −10°C to +165°C, but extensive tests have shown that the battery can still perform at up to +195°C.

Other new batteries released by Varta include a range of high-capacity lithium/manganese dioxide cells for backup power in computers – the CR Series. These feature laser welding for reliability and a self-discharge rate of less than 1% per year, giving a lifetime of 10 years. The cells can also be wave soldered without special precautions.

There are four sizes available: an 'AA' size with a capacity of 2.0Ah, a '2/3AA' size with a capacity of 1.4Ah, a '1/2AA' size with 1.0Ah, and a '1/4AA' size with 350mAh.

For more information on both types of cell circle 205 on the Reader Service Coupon, or contact Varta's Australian distributor Adeal at 150 Buckhurst Street, South Melbourne 3205; phone (03) 690 4911.

Programmable AC supplies

Kepco Pacific has developed a range of GPIB programmable AC power supplies with output ratings of from 1kVA to 18kVA, and featuring sophisticated control over output frequency, RMS amplitude and phase. They also provide a transient simulation facility.

The 1kVA models in the BOP-ac Series are compact 5-1/4" high rack-mount units which incorporates in a single case the local keyboard controller, 80-character LCD display, oscillator and remote GPIB control, along with either one or three power amplifiers for single or three-phase output. The 6kVA and 18kVA models are housed in small floor-mount rack cabinets with roll-about casters, with rack-mount power amp modules separate from the oscillator/transient generator module – which may be mounted remotely.

Output voltage for the 1kVA models is adjustable from 0V to 136.5V AC, with frequency adjustable from 20 to 2000Hz. Maximum loading per phase for the three-phase 1kVA model is 500VA. The higher power models are adjustable from 0-132V AC, and from 47 to 2000Hz.

For further details circle 206 on the Reader Service Coupon or contact Elmeasco Instruments, 18 Hilly Street, Mortlake 2137; phone (02) 736 2888.

Miniature DC/DC converters

Powercube has released a range of 'Mini Series' DC/DC converter modules – rugged low profile current mode control switching regulators, which provide fully isolated and efficient power conversion from a broad DC input range.

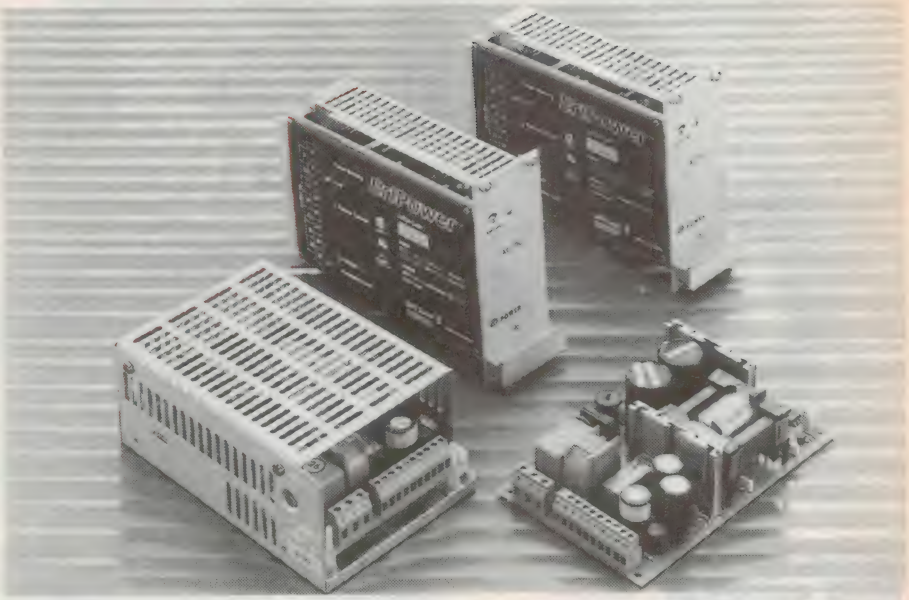
Excellent transient response and pulse-by-pulse current limiting are features of the design; the units are also 'parallelable' and load share to within 5%. Most models include overload and short circuit protection, overvoltage protection, remote sense and ON/OFF controls.

The series cover 11, 15, 20, 36, 50 and 150 watt models, with a variety of input voltage and output voltage configurations. Mil specifications include MIL-STD 461/462 – NAVSO P/3641 – MIL-STD-704 (704D) – environmental to MIL-STD-810C and MIL-STD-202.

For further enquiries circle 209 on the reader service coupon, or contact Priority Electronics, 23-25 Melrose Street, Sandringham 3191; phone (03) 521 0266.

What's New in Power Supplies

100W supply for CV chargers



Ericsson Components AB, Sweden has announced a new model of the company's range of highly reliable and efficient 60-100W switching power supplies, designated the PLB series.

The new power supplies, PLB 1116 and 6316 refer to 19" Euroformat (10TE) and Open Frame mechanical versions with screw connectors, respectively. The output voltage can be adjusted within 26-31V DC by means of a potentiometer which is accessible from the outside. Output power is 100W and hold-up time 30ms. Input voltage is 115/230V AC (47-400Hz), selected by means of a switch accessible from the outside.

The supply is primarily designed for various constant voltage charging applications in 24V DC battery systems, e.g. in emergency equipment or as a general source for 28V DC systems. Two supplies connected in series can also be arranged to charge a 48V DC battery system, where the interconnecting mid point is used to divide the battery into two 24V systems, thereby facilitating a more uniform cell charging performance.

The supplies feature constant current limitation characteristics and tight regulation at low load conditions, an important parameter for the batteries' lifetime when charging in stand-by mode. It also facilitates easy parallel operation of several units, a valuable feature for upgrading and redundant power applications.

For further information circle 210 on the reader service coupon or contact Ericsson Components, PO Box 95, Preston 3072; phone (03) 480 1211.

Low cost DC-DC converters

Recently released in Australia are the KEIC range of low cost DC-DC converter modules.

The KEIC range features high efficiency and low output ripple, provide 500V DC isolation, and are available as 12, 24 and 48V DC input models with standard 5, 8, 12 or 15V DC output in 10, 15, 20, 25, 40 and 60 watt power ratings.

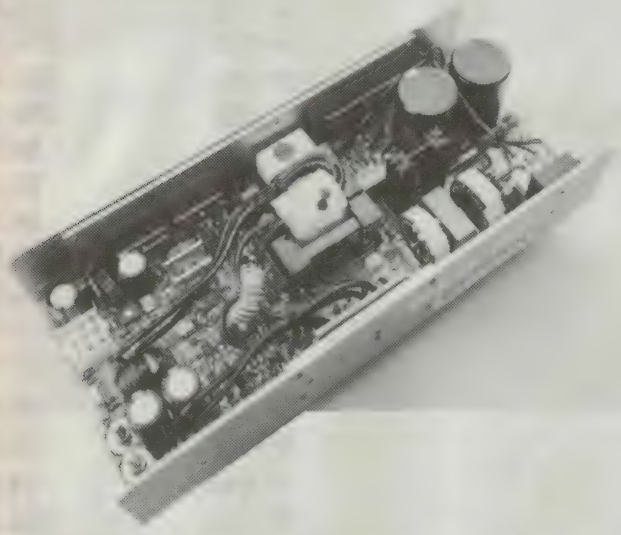
The modules are of rugged metal/plastic construction ready for easy PC board mounting. KEIC offers this very comprehensive range of DC-DC converters at competitive prices.

For further information circle 214 on the reader service coupon or contact Quiptek Australia, PO Box 335, Black Rock 3193; phone (03) 532 1328.

Three output, 340W switchmode supply

Setec's model SM340AC1 power supply provides one 5V and two 12V outputs and meets all major EMI regulations, making it useful in a wide range of applications.

Boasting the full gamut of protection features, the SM340AC1 is not only virtually indestructible, but offers protection of the load as well.



Should a fault in the load circuitry concentrate the supply's full current output into the load, there may be a fire danger, or at the least, the risk of costly damage. The supply has a sustained overload shutdown facility that protects against this.

In addition, it has over-voltage shutdown on all three outputs and a thermal shutdown facility protects against cooling fan failure.

The SM340AC1 is UL recognised (E132182), TUV licenced (EOO98411) and CSA certified (LR83957-4). A choice of two nominal AC input voltage ranges is provided: 200-230V and 100-120V, 48-62Hz.

For further information circle 208 on the reader service coupon, or contact Setec, phone (03) 762 5777.

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New low cost UPS's for PC's

Up until now, most users of personal computers couldn't even consider the use of an uninterruptible power supply for protection against power breaks – because most UPS's have cost almost as much as their computers. But this needn't be the case any more, thanks to a new range of *really* low cost UPS models just released by Lumen International Electronics.

by JIM ROWE

The uninterruptible power supply or 'UPS' has been around for a long time. Telephone companies were the first to use them, albeit in their own form, to ensure that their systems kept working regardless of variations in the local power.

Even the kind of supply now implied by the term 'UPS' – one which effectively maintains the 240V AC mains supply – has been around for quite a while. Almost as long as the computer, in fact. From memory the first UPS's were used to protect mainframe computers, as soon as they developed to the point where they didn't require almost a full substation to power them!

Unfortunately as computer technology

has forged ahead, providing more and more processing power in ever smaller and cheaper boxes, UPS technology has tended to fall behind a little. Small UPS models *have* become available, but generally with price tags so high that for most users their use with today's personal computers has been 'out of the question'. In some cases, the price of an appropriately rated UPS would be higher than that of the PC it would be protecting.

And yet the kind of protection afforded by a UPS is just as important for a personal computer as it is for a larger machine – as anyone who has lost data due to a power blackout will know. There's nothing quite so depressing as seeing the lights go out, and then realising that the last time you pressed the 'Save' key was a couple of hours ago...

Most PC users could really benefit from a UPS, then, to save them from this kind of trauma. The trouble is that until now, the things have been *so expensive* that they could only be justified/afforded by either well-heeled organisations, or those whose work was work so important that they just *couldn't* afford to lose it.

But that isn't the case any more, thanks to a breakthrough by a firm you've probably never heard of: Lumen Electronics.

Based originally in Taiwan and now an international organisation with branches in the USA, Europe and Australia, Lumen is actually the largest manufacturer of small UPS's in the world, and has been making and selling them since 1980. In fact there are well over 250,000 of their UPS models now in service, with the endorsement of and accreditation from most of the world's leading computer makers.

The reason why you've probably never heard of them is that just about all of those UPS's carry other firms' brand names – including those of (you guessed it) many of the world's leading computer makers. In fact up until very recently, most of the UPS's made by Lumen were sold to OEMs for resale as their own products. It's only recently that the firm decided to set up its own marketing organisation, and sell its products directly under the 'Lumen' and 'Upsonic' brand names.

The first UPS models they released in this way were fairly conventional ones, with ratings of from 250VA to 5kVA and designed to deliver the traditional smooth sinewave output with all the usual 'bells and whistles'. And as you'd expect, these had price tags much the same as those of their competitors; even the 250VA model was fairly pricey.

But Lumen was well aware that the majority of PC users – a huge potential market – were still not taking advantage of their products. So they decided to go and ask some of these reluctant customers just what kind of UPS they *would* go for. And the answers were quite informative.

It turned out that the main factor deterring most people from buying a UPS was – you guessed it again – price. The price would have to be lowered quite a bit before they would even consider buying one. But on the other hand, it also transpired that PC users don't necessarily want a UPS that is capable of running their computer for very *long*.

In fact all the average PC user really wants, they found, is a unit that would keep their system going for a couple of minutes, while they saved data files and backed out of their software, before turning everything off. They don't really want to keep on working all the way through a blackout, with only the glow from their monitor screen to light up the desk and room...

Armed with this information, Lumen set its UPS design engineers the task of coming up with a range of new models that would be much cheaper than their existing designs, yet provide all of the protection that PC users needed. The new Upsonic 'PC Might' Series is the result.

There are three models in the series, designated the PC Might-25, -35 and -55. These have load capacities of 250, 350 and 550VA respectively, and collectively cater for just about all normal personal computer models. Yet they sell for prices that are significantly less than *half* that of competing models of similar load capacity. For example the model -25 has a list price of only $299 plus tax, compared with around $795 for similarly rated conventional models.

As well as being much cheaper, the new models are also much *smaller and lighter* than conventional models. For example the mid-range model -35 measures only 308 x 150 x 85mm, and weighs a modest 6.2kg – including the inbuilt battery. In comparison, a conventional model with similar output VA rating measures 560 x 260 x 215mm and weighs a solid 23.6kg.

So Lumen's new PC Might series represents quite a breakthrough in small UPS design. But how have they done it?

Firstly, by bringing the backup runtime capability down to a more realistic figure. The new models typically provide a rated backup runtime of about 6 minutes, compared with the 15-20 minutes provided by many conventional models. This is still more than enough time for a personal computer user to save files and back out of a system, of course; yet the reduced rating allows quite a saving in battery size and cost.

Quite apart from this, Lumen's engineers discovered that because virtually all modern personal computers now use switch-mode power supplies, they are much more tolerant of the input AC waveform. It really isn't necessary any more to make the UPS generate a pure AC sinewave in backup mode, even though this is still done with most conventional designs.

A modified squarewave or 'quasi-sine' waveform is quite acceptable, it turns out, and generating this kind of waveform is rather easier and cheaper. The circuitry is also more efficient, and it's this that allows everything to be fitted into a significantly smaller case.

Impressive specs

The specification for the mid-range PC Might-35 gives a good idea of the overall performance achieved in the new series.

The model -35 has a 350VA/210W output rating, and is intended for use with a typical 'AT' computer and monitor, or similar machines. It has a rated

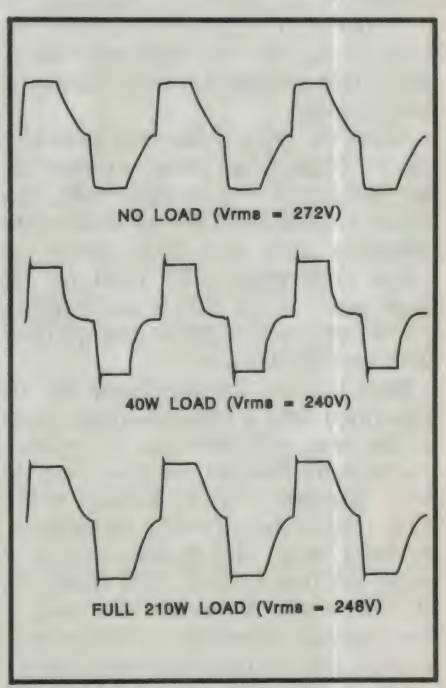

Fig.1: The output waveform from the sample PC Might-35, under various load conditions. For the majority of modern PC's, it's near enough to a sinewave...

backup runtime of 3-4 minutes at full rated loading, or 8-10 minutes for half the rated loading. Typical transfer time from AC line power to backup power is rated at 4 milliseconds – well within the 'hold up' tolerance of the vast majority of PC power supplies and reset systems.

The backup battery is a single sealed 'zero maintenance' 12V/7Ah lead-acid type, with a rated recharge time of 10-12 hours after full discharge. Essentially what this means is that if you save and turn off within a minute or so of the power failing on each occasion, the UPS should be able to offer continuing protection even if there are repeated power failures in relatively rapid succession...

Like the other models in the PC Might range, the -35 also provides a useful measure of protection during normal AC line operation, against surges, noise and spikes. It can dissipate up to 90 joules, or 4.5 megawatts for 20 microseconds, and clamps the incoming AC wave to 370V peak amplitude. In addition, it provides at least 20dB of attenuation for RFI in the band from 100kHz to 100MHz.

Rated noise level of the model -35 during normal AC line operation is a very quiet 55dB at 1m, rising only slightly to 60dB in backup mode. Heat dissipation is quoted as 'minimal', in both modes. Overload protection is via fuses in the AC line input and battery lines, plus current limiting circuitry in backup mode.

When the -35 and the other models in the PC Might range detect a power failure and switch into backup mode, they sound a small piezo beeper to alert the computer user that files should be saved. The green pilot LED on the front panel of the UPS is also switched on and off, presumably to prompt those with impaired hearing.

Both the -35 and the larger -55 are also fitted with a DB-9 interface socket at the rear, with two sets of switched connections. One set operates when the UPS changes over to backup mode, with a mains failure, while the other set operates when the battery reaches a point just before final UPS shutdown. By connecting this socket to a port on the computer, software can be arranged to save files and prepare for shutdown automatically when mains power fails while the computer is unattended.

All models in the PC Might range are accepted by the SECV, by the way, and hence automatically accepted for use in all Australian states. They also come with a 12-month parts and labour warranty.

Inside the sample PC Might-35. The backup battery occupies about half the volume, and together with the power transformer provides most of the modest weight. The main switching devices are at the front of the top PCB.

Trying one out

Lumen Electronics very kindly loaned us a PC Might-35 for review, so we had the opportunity to put it through its paces.

After allowing it to run for about 12 hours, to ensure that the internal battery was fully charged, we tried it out with an 'AT' compatible computer system with the usual complement of hi-res colour monitor, hard disk drive and twin floppy drives. The system also happened to have a memory expansion card with 2MB of additional RAM, and an external modem – bringing the overall load very close to the model -35's rated figure of 350VA/210W.

Incidentally so that we could safely monitor things like the output voltage, waveform and frequency of the UPS, we used a 500VA isolation transformer on the mains input side. To simulate power failures we simply switched the input to the UPS off when required, at the output of the isolation transformer.

First of all we checked the ability of the -35 to cut in quickly enough with the backup supply, to prevent the computer crashing or otherwise coming to grief. This was done by switching the supply off and on at approximately 30-second intervals, about 25 times.

The result? The computer simply kept on operating normally throughout the procedure, without batting a metaphorical eyelid. In fact we tried to observe the 'glitch' or 'notch' in the output waveform from the UPS, at each moment of switching off. This wasn't at all easy, without a suitably triggered storage scope, but as far as we could see switchover was taking place well within the model -35's rated 4ms.

By the way, we noted that when the AC line power is restored, the UPS waits a few seconds before switching back again. Presumably this is to ensure that the power really has returned in a stable manner.

We then monitored the UPS output with the instruments, in backup mode (i.e., no AC mains input). The waveform is perhaps best described as 'a square wave with a bite taken out of the trailing end of each half-cycle'. The size of the 'bite' varies somewhat with loading, as you can see from Fig.1, but under all conditions of loading it still appears to be within the acceptable range for modern switch-mode supplies and monitors.

Incidentally the RMS output voltage varied from 272V with no load, through 239V with a 40W lamp load, to 248V with the computer system load. Output frequency remained stable at 50.3Hz, regardless of loading.

Finally we allowed the battery to charge up again, and checked the model -35's holdup time: how long it would

run the computer system all by itself. We could do this quite safely with the computer concerned, as its hard disk drive is of the 'auto parking' type which parks the head automatically when power is removed. Needless to say, we made sure that all essential files were saved, and also that the computer was not running any software that could be corrupted by a sudden shutdown.

It turned out that the model -35 ran the computer for just over 15 minutes – well beyond the rated holdup time. This suggests that the rated figure is quite conservative, and probably makes allowance for the fact that the battery capacity gradually diminishes over its rated lifetime of 3-5 years.

Incidentally, as with most other UPS's the PC Might units don't simply run until the internal battery is totally exhausted. They simply shut down as soon as its terminal voltage falls to a predetermined threshold. This not only protects the battery from damage, but also ensures that the UPS circuitry isn't forced to operate under conditions where it can't maintain the output voltage at the correct level.

Hence the computer it protects doesn't gradually find itself trying to operate with an inadequate power input; the power is either there at the correct level, or it isn't. An important point, because otherwise the computer might start behaving quite strangely...

I guess I should also note that the model -35 ran very quietly, with only a modest hum evident in backup mode. It also ran very cool, suggesting conservative design.

All in all, then, the performance of the sample Upsonic PC Might-35 was very impressive. It seems capable of doing the job extremely well, maintaining computer operation reliably through repeated mains failures and giving more than enough time to save files and switch off. Lumen's designers are to be congratulated for achieving this order of performance from such a compact and low priced unit.

The quoted list price for the model -35 is $490 plus tax (if applicable), which seems very good value for money. So now just about any PC (or Mac, or Amiga, or whatever) user can have the protection of a UPS, without parting with a further arm or leg!

For further information on the new Upsonic PC Might series, circle 210 on our Reader Service Coupon or contact Lumen International Electronics at 18 Amberley Crescent, Dandenong 3175; phone (03) 792 4203.

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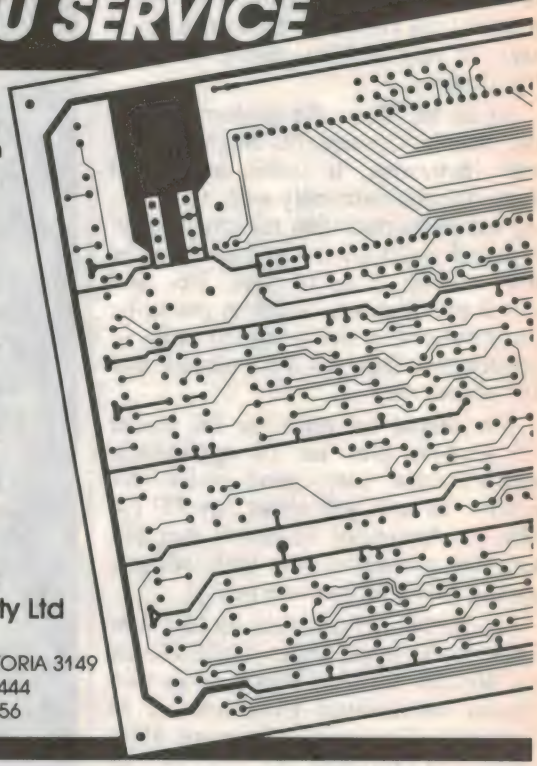

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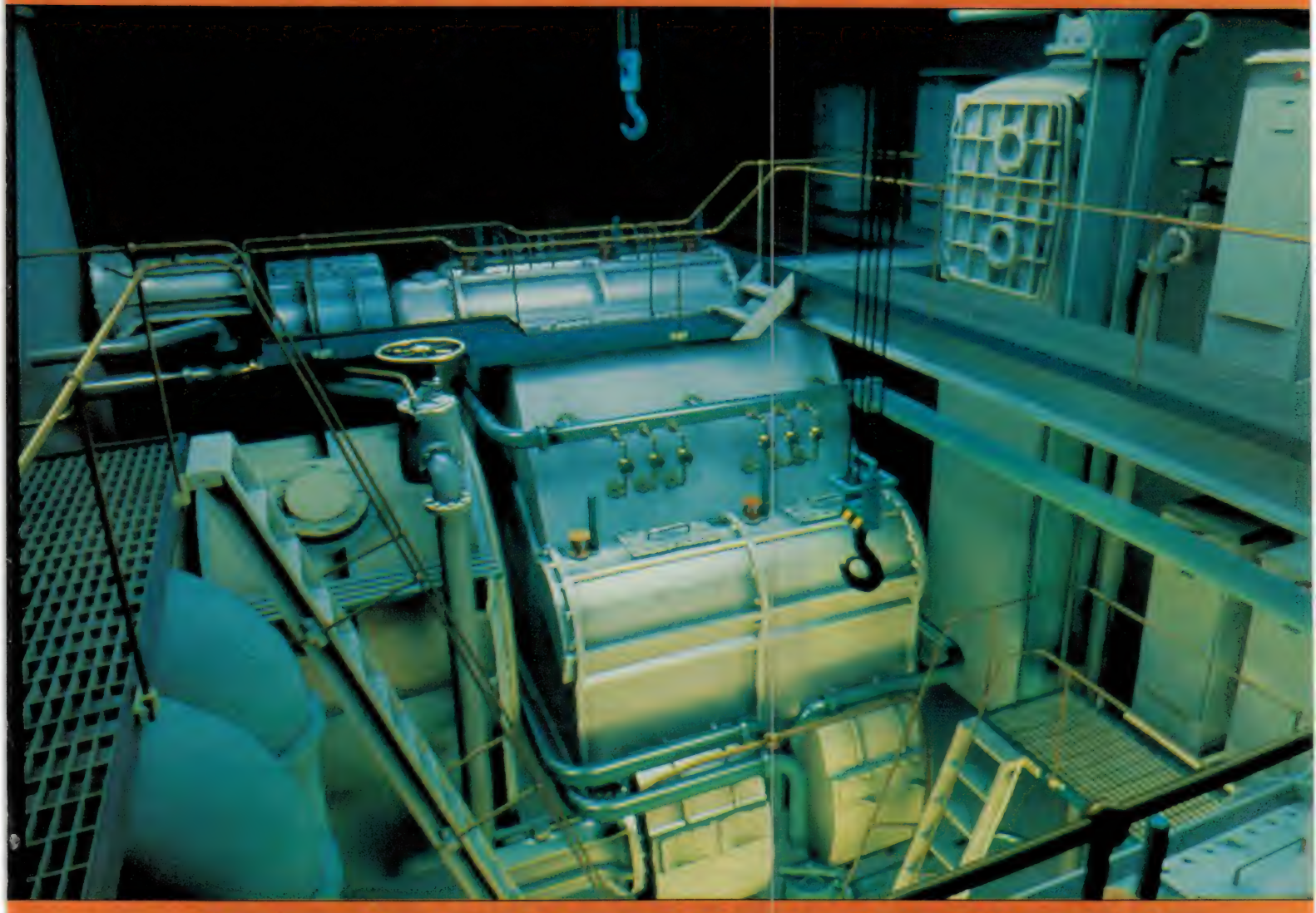

Hi-res graphics from HP's new 9000 series 'Turbo SRX' workstation

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The first laptop portable computers with full colour flat LCD screens are now appearing. The performance is outstanding, but unfortunately so too are the prices. Here's a look at how the new screens work, and why they're so expensive.

by RORY J. O'CONNOR

Most chip makers are searching for ways to make miniature semiconductors even tinier, shrinking the space required to store data or cradle a computer's 'brain'. But a few Japanese firms are tackling just the opposite problem. They are perfecting the art of making chips as big as a magazine page, that can display a crisp, full-colour computer image – chips that could replace bulky cathode-ray tubes in computer screens.

The chips are the most sophisticated versions to date of liquid crystal displays, known as LCDs – the flat computer screen familiar to people who use portable and lap-top computers. Like those screens, the new ones are much thinner and lighter than CRTs and require far less power to operate.

Smaller versions of the new-technology panels, measuring from 50 to 125mm diagonally, are already used in electronic appliances and equipment ranging from hand-held televisions to automobile dashboard displays. But larger panels measuring about 300mm and suitable for computer displays have only recently begun rolling off Japanese semiconductor manufacturing lines, largely because of the immense problems involved in making the devices.

The active matrix colour display in Dolch's new 80486-based laptop portable provides a brightness and clarity very comparable with conventional CRTs.

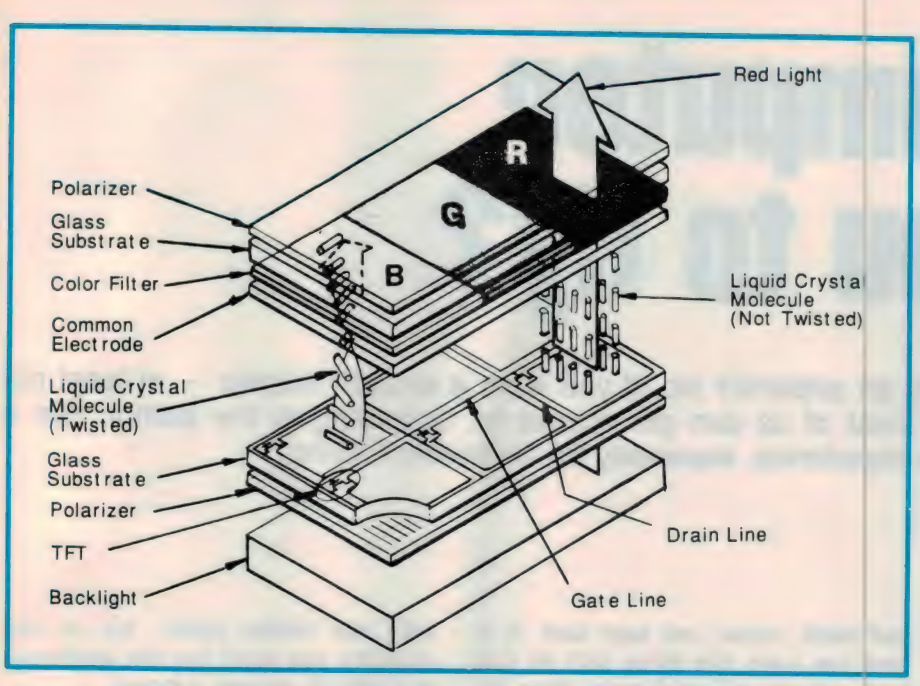
Dolch is first

Now only two companies – Sharp and Hitachi – are selling the expensive screens, which are called thin-film transistor, active-matrix LCDs. Only one US computer company, Dolch Computer Systems in San Jose, actually sells a computer system incorporating such a panel. Another company, Dauphin Technology of Lombard, Ill, had plans to offer the screens on its high-end portable computers starting in September, and Sharp had pledged to make such a machine by the end of the year. *Editor's note: it's already available in Australia...)*

Eventually, the screens could become standard issue in portable computers. And, with lap-top computers expected to displace desk-top systems for many uses, the screens could also eventually squeeze the CRT out of its dominant role in computer displays.

"In a couple of years, no one will disagree that this will be the display of choice," said Volker Dolch, president of Dolch Computer Systems – a spin-off from his other firm, Dolch Logic, a manufacturer of high-end logic analysers. "The image quality this yields will eventually outdo CRTs."

Compared with the first efforts to make flat-panel colour displays, the new screens are a vast improvement.



Dolch's active matrix colour display packs over 920,000 thin-film transistors (TFT's) onto the glass substrate – one for each pixel.

Transistor control

The improvements are due in large part to the use of thin-film transistors (TFT's) to control the liquid crystal panel directly, in the so-called 'active matrix' system. Thin-film transistors, embedded in glass directly behind the liquid crystal panel, permit more precise control of the image on the screen than do older designs.

While the images produced by this new technology are stunning, so are their price tags. Dolch's system, using an Intel 80486 microprocessor, costs about US$16,000; its 26.7cm Hitachi screen alone accounts for $4000 of the price. Dauphin's machine will cost about $10,000 but will use the less advanced 80386SX microprocessor.

Prices probably won't come down significantly for at least a year, predicted Dauphin president Alan Yong.

"I expect to see a 20 to 30% drop in system price in 12 to 18 months, and the screen cost will drop even more," he said. "The same system we'll offer for US$10,000 will sell, in September 1991, for $7000 to $8000."

Steve Sedaker, Sharp's marketing manager for display products, said "By 1992, we'll be in a position to drop the price significantly and sell to more people."

For now, though, the screens are sold primarily to buyers who absolutely need colour in a portable computer, including some programmers, field engineers, designers, medical specialists and the military, Yong said.

Low yields

The screens are pricey because they are complex and prone to manufacturing defects.

Each screen is a large semiconductor, with more than one million transistors etched onto its precision glass surface. In traditional chip manufacturing, where there are numerous individual chips on each large silicon 'wafer', the inevitable defects are scattered around the wafer, leaving many perfect chips. With thin-film transistors, there's only one chip per 'wafer', so every defect on the wafer affects the chip.

And thin-film transistor defects are glaring. Defective transistors show up on the screen as either an annoying spot of colour that won't go away, or as a permanent dark spot. As few as six defective spots scattered about the screen can scrap the whole unit.

To guard against that, manufacturers typically etch four transistors into the glass for each pixel on the screen. Thus, if one of the transistors is defective, three others are still functioning.

Still, the number of discarded units is startingly high. Manufacturers are reluctant to discuss specifics, but most experts say fewer than 10% of the screens coming off the assembly lines are good enough to be sold.

There are plenty of other parts of the complex manufacturing process that can go wrong too. The glass, colour filters and electronics have to be precisely manufactured and assembled.

Each step contributes to the low yields – and there's no way to spot a bad screen until it has been assembled and a test image has been displayed.

The result: the screens cost more than US$2000. Even for US consumers, that translates into a premium of $3000 to $4000 to equip a computer with a colour active-matrix LCD instead of a monochrome model.

Few customers

There's not much quantity, either. Sharp hopes to produce a few thousand screens a month by the end of the year and as many as 4000 a month by the second quarter of 1991, Sedaker said.

That's not a problem yet, because at the price, there are few buyers.

"We only plan to sell several hundred through the summer," said Dolch, who expects his volumes to increase after September, when Hitachi opens another manufacturing line for the screens.

And when the buyers finally begin to line up, the Japanese will cash in. Besides Sharp and Hitachi, companies like Mitsubishi and Seiko are said to be working on the technology, and Toshiba has produced prototype screens in partnership with IBM's Japanese division.

One reason the Japanese are alone in developing the technology is that few US companies or investors have been willing to put money into a venture where the payoffs are three to five years away. And a large amount of capital is required: at least one expert figures it costs a manufacturer US$100 million every time it wants to increase the size of the screens it makes. Sharp says it will invest US$1 billion in the technology over the next two to three years.

Meanwhile, the Japanese have used their virtual monopoly in consumer electronics to their advantage, spending several years experimenting with smaller versions of the screens. Already, there are 125mm screens that sell for about US$1000, used mainly in automotive applications. There are even smaller, more common screens used in hand-held video players and electronic games.

"One of the real advantages the Japanese have is their experience in consumer electronics, most notably hand-held televisions," said Mark Singer, a spokesman for chip maker Cirrus Logic in Milpitas, which produces controller chips for thin-film transistor screens.

The Japanese may also use that experience to help them make the thin-film screens more attractive to buyers.

"With a flat panel, you can mold it into the desk-top if you want, too," said Sharp's Sedaker. "There are a lot of options".

Can a computer teach you to fly?

Can a computer teach you to fly an airplane? No, if you want a straight answer – at least not with the kind of computer that most of us can get access to, according to the author. But a computer can give you valuable experience, especially for 'instrument' flying...

by TOM MOFFAT

To learn to fly, there's really no alternative. You are going to have to pay your money and physically sit in a real aircraft, next to a proper human instructor.

But what a computer *can* do is give you some preparation in advance of this 'real' instruction. It will also give you some extra practice during instruction, and it will open the door to instrument flight – something the average private pilot would never attempt otherwise.

The 'instrument' bit is the part that electronics enthusiasts will go into a spin over. We read these magazine articles about all the latest 'avionics' gadgets, and now the computer gives you the chance to learn to use them, master them, and play with them to your heart's content. You cough up the equivalent of a night out on the town, and for your money you get an instrumentation package worth tens of thousands of dollars in real life.

What we're talking about here is a Microsoft's *Flight Simulator* which has to be one of the most clever and elegant computer programs ever written. In this article we will play around with Version 3, which isn't the latest version. There's a Version 4 now, but I'm told it's only really useful on up-market IBM-PC's of the type found more in businesses than homes. There are also versions for Macintosh, and I believe Amiga as well.

I've got Version 3 running on a simple PC-XT clone, of the type you can pick up for $600 or so on the used market. Version 3 also goes nicely on a Toshiba laptop.

When you run the program your first task is to learn to fly an airplane; otherwise the software sits there and does nothing. The instruction manual gives concise instructions on how to take off and climb, cruise, and later land. It is here you learn that flying isn't all that easy, and you will crash many times before finally experiencing a successful flight. The nice thing is, crashing is of absolutely no consequence. After all, this is only a simulator. You can even program the plane to 'bounce', instead of crash.

Every time you leave the ground your activities are recorded in an electronic 'pilot's logbook' (this is optional – you can turn it off). But here, a word of warning: logged time on a home computer flight simulator is NOT counted as proper flight time by any aviation authority in the world, as far as I know. If you need 'X' number of hours flight time to reach a certain qualification, you MUST do those hours in a real airplane!

For intending or trainee pilots, the value of the simulator comes from the extra practice it gives you in aircraft handling and navigation. So if you're off on a cross-country flight in a real plane, and the needle on a navigation instrument says you're off course, you don't have to ask yourself 'now which way should I turn the controls to correct it?'. You already know, from experience on the simulator, so you can concentrate more on the navigation task at hand.

This means that after 20 hours 'real' flight time or so, you will probably be a much better pilot than if you had never touched the simulator.

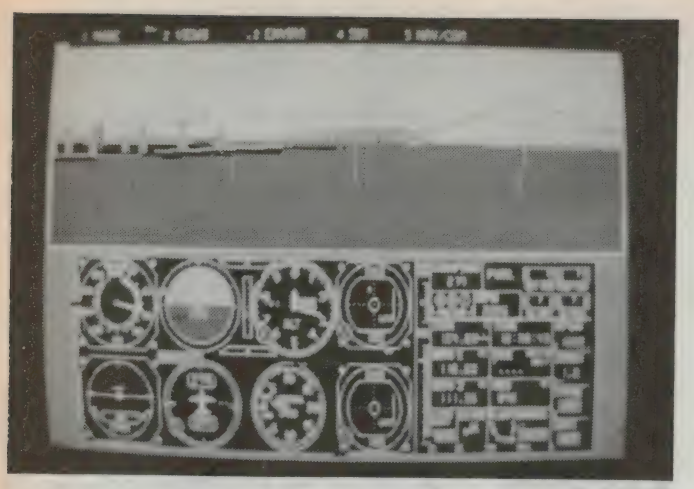
I did pilot training up to private pilot standard in America several years ago, and I feel I could have improved much quicker had I had a flight simulator like this to practice on between lessons. But there are some limitations in the computer. Foremost is the way you drive it – on an airplane you have a control yoke and rudder pedals, but on the simulator you must use the keyboard, or a joystick, or even a mouse.

One of the first things you learn in real flight is coordinated turns; getting the feet on the rudder pedals working with the hands on the control yoke, so that the plane turns and banks properly instead of slipping along sideways. On the computer there's nowhere for your feet, so you must use several keys at once, or two joysticks, or a thing called an auto-coordinator which links the rudder pedals automatically with the control yoke.

Some real aircraft have auto-coordinators, but one wonders if you could ever learn to fly properly without learning coordinated turns. The lack of rudder pedals also means certain aerobatic maneuvres are impossible, as is the common technique of 'side-slipping' to bleed off excess speed or altitude prior to landing.

Much of the art of flying comes through the sense of *feel* – the origin of the term 'flying by the seat of your pants'. You can feel if you're going too fast (the controls get stiffer) or if you're going too slow (a stall is signalled by mushy controls and by the aircraft trembling). When a stall actually happens you know the aircraft is dropping out of the sky because your stomach ends up in your mouth. The flight simulator has no 'feel' at all – your only feedback is visual, with occasional noises from the computer's speaker.

There's also the problem of vision. In a real airplane the pilot is always looking ahead, left, right, up, down. During landing from a circuit, the pilot positions the plane so the runway is slightly behind him before turning onto the 'base' leg. A 'real' pilot only has to ro-



Heading for the Oakland Bay Bridge at 280 feet, 80 knots, with flaps right down. San Francisco is on left.

Ready for takeoff, on Oakland Runway 27.

tate his skull to see these things, but on the flight simulator more frantic pressing of keys is necessary to look out the various 'windows'.

Still, feeling and looking out is only a small part of what the flight simulator is about. Its real strength is in its instruments.

Avionics

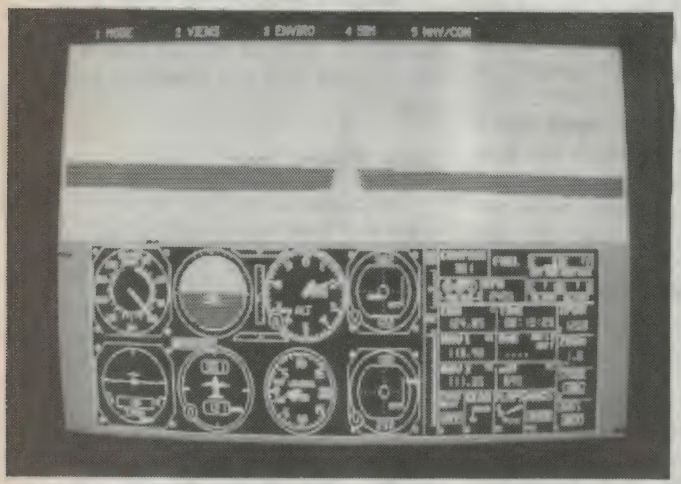
The accompanying photos of the computer screen show that the bottom half of it is taken up with what's known as a 'standardised instrument cluster'. This follows the international convention of trying to get the same instruments in the same place on most planes, so any pilot automatically knows which way to glance for what. The six left-most instruments are found on nearly every aircraft, whether rated for 'instrument flight' or not. These rely primarily on mechanical instead of electronic techniques.

At top left is the airspeed indicator, which indicates how fast you're going through the air. This is not necessarily the ground speed, since wind speed must be taken into account. Next along is the artificial horizon, which uses a gyroscope to maintain a level reference regardless of the bank or pitch of the plane. It is intended to show a view of the horizon, even when vision out of the aircraft is obscured. Third along is the altimeter.

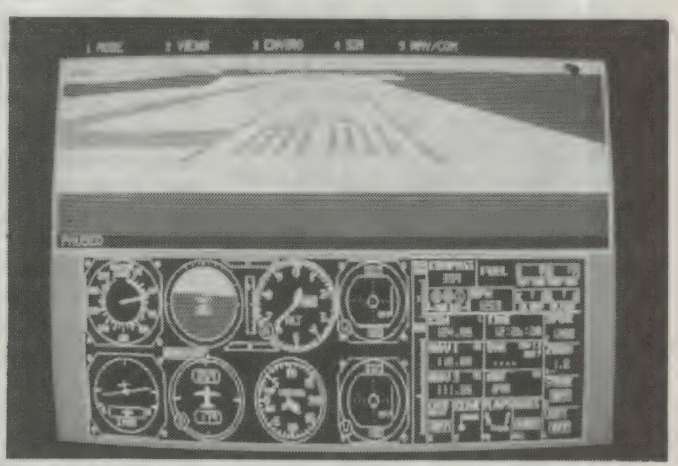
First on the bottom row is the turn and bank indicator, used primarily to assist in co-ordinating turns. Next is the directional gyro, an instrument that displays the aircraft's heading without the sluggish response of a compass. Third is the vertical speed indicator, which gives a very sensitive reading of how fast the aircraft is climbing or descending.

To the right of the previous six instruments are two more, one above the other. These can either be two VOR (voice omni-range) units, or one VOR and one ADF (automatic direction finder). What you see on the panel are only the read-outs of some very sophisticated electronic systems. What comes into the systems usually arrives by radios, mounted one above the other in the 'radio stack' – the square section at the far right of the panel. This also contains some engine instruments and a few displays exclusive to the flight simulator, such as the degree of magnification of the window view.

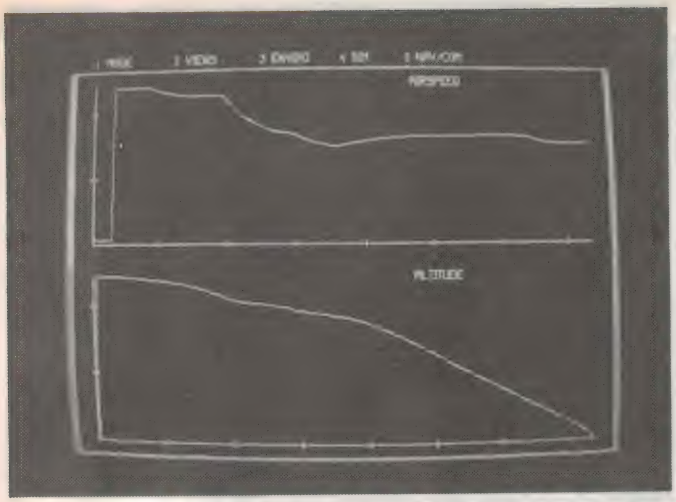
Other than the few extras, this instrument display looks EXACTLY like the real thing. The program's designers have gone to great pains to reproduce every possible detail of the instrument cluster. You can clearly read the tiny numbers on the airspeed indicator and the other gauges. The images shown were produced on a Hercules monochrome graphics card which has very fine resolution. The simulator also supports many versions of colour screens, as well as the LCD screen of a laptop.



Approaching the Empire State Building at 1180 feet and 100 knots. King Kong is nowhere to be seen!



About to touch down on Runway 36 at Meigs Field near Chicago. The altimeter is still showing 650 feet since this airport is 560 feet above sea level.



The simulator will give a graphic analysis of altitude and airspeed, after a sloppy landing.

Flying along the runway moments after a 'short field takeoff' from Meigs Field.

Navigation

One of the hardest parts of flying is navigation – working out your path from A to B, plotting the various headings and altitudes required, and then sticking to them. A long cross-country journey is more than just a straight line from here to there. You will probably zig-zag a bit to take advantage of various navigation beacons that aren't right on your intended track. And you have to find places to refuel along the way.

This means every time you've finally settled down onto a nice heading and altitude, you have to start planning for the next course change that may come within minutes. The cockpit is a busy place, and the more practice you can get doing all these chores, the better off you're going to be. Much of this practice can be with your computer.

Much of the work is done in advance of takeoff, to produce a 'flight plan'. You decide in advance to first track to a particular VOR station on such-and-such a 'radial', and then move to another outward radial to intercept some other radial from the next station along. When I was training this was the most common type of navigation, and was known as 'VOR hopping'. It is still used extensively by light aircraft.

Radials can be considered an infinite number of 'beams', transmitted from each VOR navigation station in all directions. The stations are marked on maps with circles drawn around them, calibrated in degrees. You can lay a ruler on the map from the centre of the circle to the place you want to go, and then read the 'radial' degrees required from the calibrated circle.

To fly along that radial to the desired point, you tune in the frequency of the VOR station (it's VHF), and then turn a knob on the VOR indicator to set it to the required radial number. Then you fly off in the right general direction, and when the needle of the VOR indicator is centered, you are on your radial. So all you have to do is steer to keep the needle centred. This takes a bit of practice to get right, and is an ideal use for the flight simulator.

Your 'desired point' might just be some arbitrary place you have chosen to intercept a radial from another VOR, so you can then fly to it. This is where the second VOR receiver comes in handy; you can set them both up in advance with the correct frequencies and radials for two VOR stations, and when both needles are centred you simply turn the aircraft off one radial and onto the other. It's also obvious that the point where the two radials intersect is closely defined on the map, so you can get a good accurate position fix.

All this VOR magic comes from a clever technique that's been around for a good many years – possibly from the 1950's or earlier. The VOR transmitter actually sends out two signals; one which is constant, and the other which varies in phase compared with the first one. If the second signal appears to be say 275° advanced in phase from the reference signal, then you're on the 275° radial. Simple, eh?

The ADF instrument doesn't really need a special transmitter; it simply points its indicator needle at whatever station it is tuned to. If the needle says 270° the station is off to your left, and if it shows 0° you're heading straight for it. Stations for ADF use are on low frequencies, below the AM broadcast band.

In Australia ADF stations are known as NDB's or *non-directional beacons*, and with a communications receiver you can usually hear a fair collection of them at night. They identify themselves with slow morse code, and some carry the ATIS signal (automatic terminal information service) which repeats a recorded message over and over, describing the weather at that airport. The ADF isn't just restricted to NDB's; it can home in on an AM broadcast station if an NDB isn't available.

Then there's the ILS (instrument landing system) and DME (distance measuring equipment) and the CFPD (command flight path display). We could go on and on, trying to describe the lot, but there's not space for that.

Suffice to say the flight simulator has the works (a 'full panel'), and every single instrument is there waiting for you to try it out. You could easily blow a whole Sunday afternoon flying a big circle tour of the Puget Sound area of Washington state in the USA, and then do a full blind instrument landing at Seattle to finish it off. If you're really cheeky you can use Boeing's own airport.

Joy flight joys

Once you've learned to fly the flight simulator you can do things that in real life would certainly blow your licence, or even kill you. The simulator has some fairly detailed scenery built into it, particularly of the more populated areas of the USA (USA only, I'm afraid).

I did my training at an air school south of Reno, Nevada. The airport was in a long valley flanked by the Sierra Nevada mountains, and on the other side of the mountains was Lake Tahoe. We were forbidden to fly over the

mountains, or go anywhere near Lake Tahoe.

Reno Airport is in the flight simulator, as is Lake Tahoe and another airport near the lake. So I broke the flight school rules with my computer – took off from Reno, zoomed around Lake Tahoe a couple of times, buzzed it at only 100 feet above the water, and then landed at the nearby Truckee-Tahoe airport. What fun – take that, instructors!

It is also possible to take off from Oakland airport, which is just across the bay from San Francisco. If you then turn right about 30° and level off at 150 feet, you can fly right under the Oakland Bay Bridge (this is the one that was badly damaged in the San Francisco earthquake last year). Continuing on across the water, you come to Alcatraz Island, the site of the infamous prison. When you buzz the island you see that the prison is still there, along with a watchtower at its western end. Staying low and turning slightly left, you can then fly *under* the Golden Gate bridge.

Climbing and turning out over the sea, you can then duck back under the Golden Gate in the opposite direction, or perhaps buzz the city of San Francisco itself, flying among the skyscrapers. It's fun to charge straight at the Coit Tower on top of a hill, and imagine all the tourists having heart attacks!

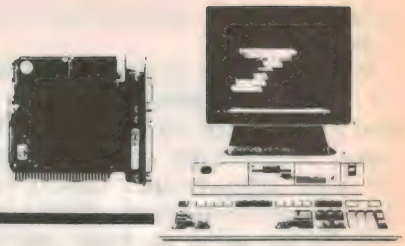
Next you can head back to Oakland, and try to sneak in under the instrument landing system. You can then land, get out, and walk straight into the arms of waiting police.

New York is also worth a giggle. The photo shows what you see as your plane races toward the top of the Empire State Building. It's like the scene from that famous movie; the only thing missing is King Kong hanging onto the radio mast with one hand while shaking his fist at you with the other, still holding the girl. This flight was not successful; the plane smashed into the building about two seconds after the photo was taken. Then again, in earlier times, I guess King Kong could have reached out and snatched me from the air!

So, a computer flight simulator isn't all work and no play. Your training aircraft is a Cessna, but if you get really brave you can swap it for a Lear Jet. Or going the other way, a Sopwith Camel. If you get lonely you can even link two computers together over the phone and fly with a friend.

There's a lot of technology in today's aircraft – and just as much, it seems, in a simple floppy disk you can plug into a computer.

Computer News and New Products



High speed security encryptor

A new data encryptor, designed to operate at high speeds, was recently launched by the Minister for Defence, Senator Robert Ray, and GSA RanData, which claims to be Australia's leading encryption company. The RD189 2Mbps data encryptor joins the new GSA RanData RD189 series of data encryptors which provide high security for electronic data transfer over telecommunications networks.

The standard RD189 data encryptor is a high speed synchronous protocol-independent unit fitted with a V.11/RS422 interface. Options include a V.35 or G703 interface.

The cryptographic security of the RD189 series is obtained by using RanData's proprietary algorithm to provide what is claimed to be an extremely high level of security.

For further information circle 169 on our reader service coupon or contact GSA RanData, 1 Hall Street, Hawthorn 3122; phone (03) 822 7858.

Catalog on disk

Maser Technology Group has released a Data Sales Catalog on disk. The Maser Technology Group is a group of companies manufacturing and distributing equipment for professional audio, radio, television, data and telecommunications.

A 5.25" MSDOS diskette, the catalog is usable on PC's or near compatibles. It contains a presentation of Maser's products ranging from consumables such as diskettes, magnetic tapes (computer as well as audio) to professional products such as professional audio, television and telecommunications products.

There are more than 1000 products presented with approximately 750 products competitively priced to assure an increase in Maser's market share. The disk may be easily installed to a hard disk and allows for quick turnaround of orders and requests for brochures.

Maser will send you a diskette Data Catalog upon receipt of your name, position and company. Simply send your details to Maser Communications - fax: (02) 985 6661.

For further details circle 168 on your reader service coupon or contact Maser Communications, 100 Penshurst Street, Willoughby 2068; phone (02) 958 6700.

Magnetic card reader for PCs

The InSwipe PC magnetic card reading system is designed to interface with IBM PC, PC-AT, PS/2 (25/30) or compatibles via a half-size plugin card. When reading a magnetic card it can emulate keyboard input, allowing ASCII character input to any existing program.

The system uses standard magnetic striped cards conforming to ANSI 4.13-1971 or ISO 2894, and reads either 1, 2 or 3 tracks recorded by FM or F2F. Software drivers allow either keyboard emulation or normal operation, with an ERE (extract, replace and edit) system allowing the extraction, editing and replacement of information as required by an application.

A compatible motor-driven model, the PCMD, provides enhanced facilities for encoding information on the cards.

For further information circle 161 on our Reader Service Coupon or contact Kahn Automation Systems, 31 Aberleigh Road, Herston 4006; phone (07) 252 9585.

Lightweight XT laptops

Sharp's PC-4700 lightweight laptop series features Sharp's quality paper white LCD screen and includes three new machines, ranging from the PC-4702 with two 3.5″ 'high density' disk drives, the PC-4721 which has the addition of a 20 megabyte hard disk and the PC-4741 which features a fast 40 megabyte hard disk drive.

The PC-4702 weighs in at only 3.6kg while the PC-4721 and 4741 weigh 3.8kgs. All three laptops operate on mains or with the rechargeable battery offering flexibility and portability for users.

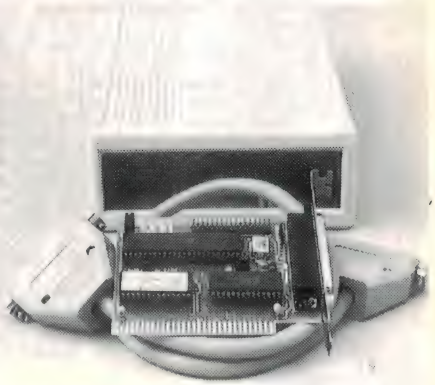
The screens employ Sharp's edgelit triple supertwist paper white liquid crystal display technology which provdes high contrast and excellent quality for text and graphics with 640 x 400 pixel resolution.

The PC-4700 series has a 79 key keyboard and is IBM PC/XT compatible. The range is also available with options including a 5.25″ 360KB external disk drive, a CRT adaptor and a 1MB EMS 4.0 memory card.

For further information circle 167 on our reader service coupon or contact Sharp Corporation, 1 Huntingwood Drive, Blacktown 2148; (02) 831 9111.

External FDD case/controller

If you need to add a different disk format (5-1/4″ or 3-1/2″), or even a tape backup to your PC, you may have problems. The disk controllers in most PCs do not take kindly to another competitor in a nearby slot. I/O and DMA clashes and BIOS address problems may lock up the poor PC or produce funny results.



These problems are a thing of the past, thanks to a brainy new disk controller and case from Electronic Solutions. The new controller fits into nearly all PCs, including cramped portables, and will happily co-exist with most hard disk/floppy disk cards. The card allows an external disk to be named e: or f: – there is no need to redefine your existing drives.

All formats are catered for (5-1/4″ 360K and 1.2MB, 3-1/2″ 720K and 1.44MB) as well as spooling tape units used for backup (20, 40, 60MB 3.5″ and 20MB 5.25″). It also supports a second (internal) floppy drive. The card is compatible with MS-DOS 3.20 and above and OS/2.

The case is stylish and rugged and accepts all 5.25″ and 3.5″ floppy drives and tape drives. It suits all PC/XT/AT/386 machines. Full installation instructions and cabling are supplied.

For further information circle 165 on the reader service coupon or contact Electronic Solutions, 5 Waltham Street, Artarmond 2064; phone (02) 906 6666.

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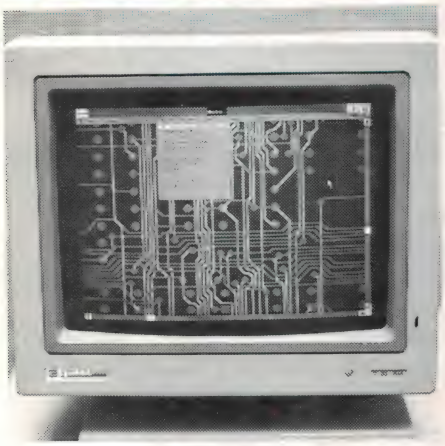

Integrated PCB design package

Cadmaster is a new integrated printed circuit design system from RCS Cadcentres and Racal-Redac. It consists of the highly versatile Cadstar PCB (V3), Cadstar Schematic and the recently released Transputer, rip-up, push aside advanced autorouter.

These three packages have in the past been sold separately, but now they come together to form what is claimed to be one of the most powerful PC-based printed circuit board design systems ever.

The power of the system is evident in three major areas. Speed, performance and price. The biggest time saving capability is associated with the Transputer autorouter, which can route the majority of well placed boards to 100% completion.

For further information circle 170 on our reader service coupon or contact RCS Cadcentres, 731 Heidelberg Road, Alphington 3078; phone (03) 499 6404.

Entry level XT portable

Kambrook has added an entry level PC/XT to its range of 'Multistation' portable personal computers.

The KAMLX20 is the cheapest, lightest and most portable of the Multistation range. A fast XT, it is based on the V20 microprocessor, which runs considerably faster than the comparable Intel chip, upgrading its speed from IBM's XT standard of 4.77 to 10.00MHz.

The display system provides a supertwist liquid display (640 x 200 pixels) with contrast adjustment and supports four keyboard switchable screen modes. It will also support an external RGB colour (640 x 200 pixels) or monochrome (720 x 348 pixels) monitor.

The KAMLX20 retails for around $1999 and features two 3.5″ internal floppy disk drives, 81-key low profile keyboard with 10 function keys, 640K of RAM, a rechargable 2 hour battery, nine pin RS-232 port, parallel port and a carry bag. It also has provision for an internal or external hard drive, 300/1200 baud internal mode, external keyboard, monitor and 5.25″ floppy drive to be added as required.

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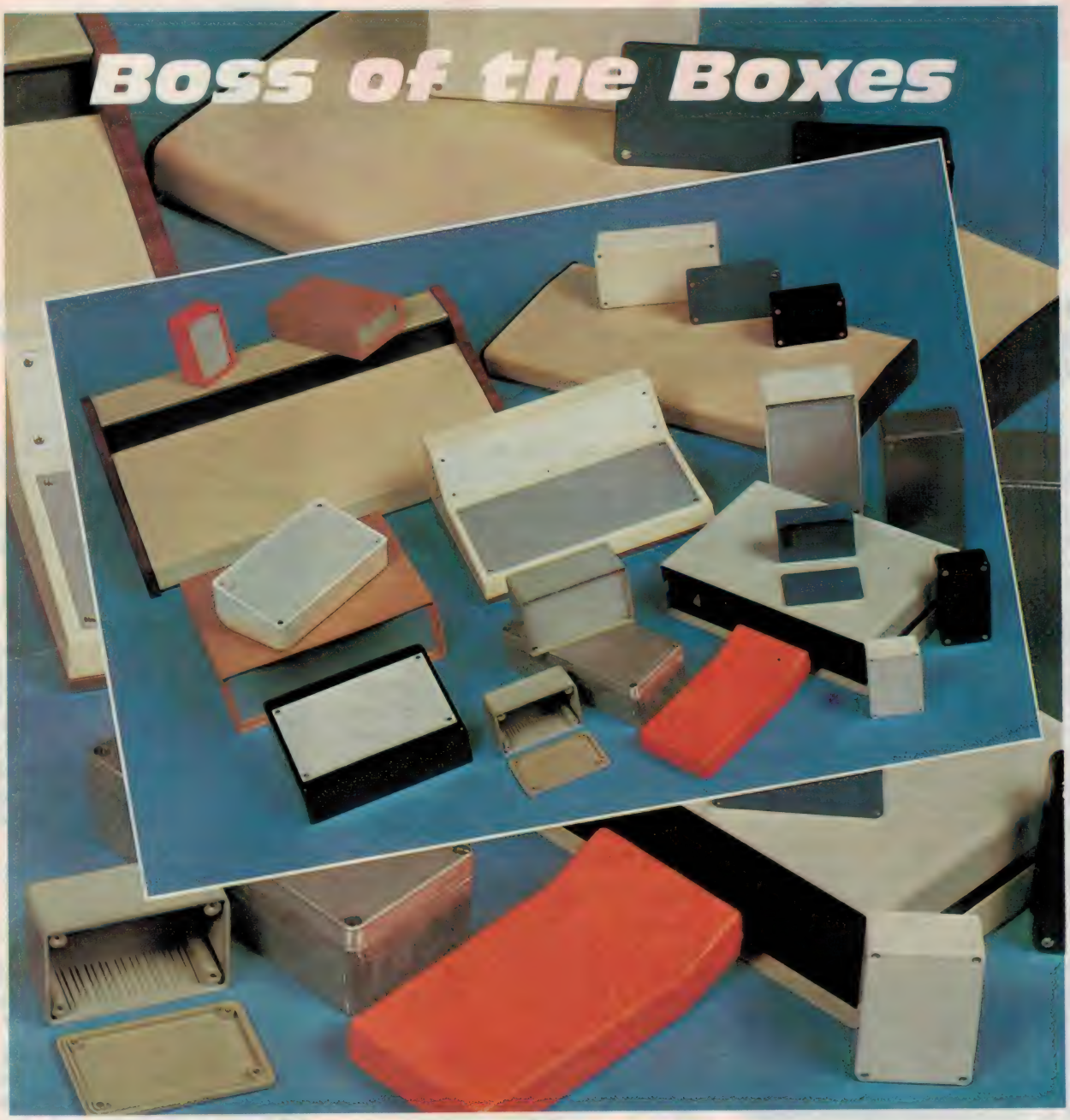

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READER INFO No. 49

PCB design for manufacture - 3

In the last part of this three part series, the author explores the financial considerations involved in choosing the right CAD equipment and points out many of the pitfalls that can be encountered before and after you have made your choice.

by RAY WHITE
Managing Director, RCS Cadcentres*

The proliferation of PCB CAD tools is creating some confusing choices for cost-sensitive buyers. Will it be PC or workstation based tools? The differences in capability and cost are getting smaller by the moment.

There was a time when 'PC-based' meant CAD tools with limited functionality – shrink-wrapped packages sold through distributors to users with limited needs and expectations. This is no longer the case. Also, PCB layout tools for PCs once supported 'small projects' – boards with less than 100 ICs and two interconnect layers – but this is no longer true. A software package for high-end PCs will offer, feature for feature, almost as much functionality as the software sold for workstations and minicomputers.

Nor are PC-based CAD tools necessarily inexpensive. The purchase and use of PCB CAD tools, even PC-based tools, is not in the same class as the purchase of a $200 word processor, or even a $496 schematic capture package. Prices for competent PCB layout tools start at $1000, and when truly sophisticated autorouting is a requirement, a fully loaded software package for high-end PCs will cost between $10,000 and $12,000. In addition to design, the best PCB CAD tools support commercial manufacturing activities. Consequently, practically any hard working PCB layout package costing below $20,000 should be considered 'low-cost,' regardless of what platform it runs on.

Choosing between workstations and PCs consequently, will depend less on the capabilities and price of software (or hardware), and more on the work style of the user and his organisation.

This is not an article to discuss the pro's and con's of different software and hardware other than to say that more often than not, most companies will purchase a design station based entirely on price with no consideration for *pay back*. That is to say a time/cost analysis based on direct and real comparisons between manual design techniques and computer aided techniques will show a payback period on a $3500 investment of just 12 months with 55-60 medium boards designed. The financial payback is easy to quantify, however there are some important points that should be used as guidelines.

Define your design task:

Conduct an in-depth study of the types of designs that you currently face, and give careful consideration to the types of designs that you will be working on in the future.

Be sure to select a tool that is a good match for your design tasks:

If your designs are constantly testing 90% or more of the system's capacity, the process will likely be slow and inefficient.

Purchase your system from reputable, knowledgeable vendors who offer a high level of support:

The joy of paying less for CAD equipment, like most other things, wears off quickly if you cannot produce results.

Invest in the best training available:

Every day spent with a good, knowledgeable instructor is a definite advantage. A novice CAD user could probably spend weeks learning the nuances and operational 'tricks' that are often not documented in manuals.

Have input from several departments and people when evaluating a CAD system:

Although it helps to have someone inside the company to act as a 'champion' to convince the rest of the company to endorse the CAD concept, the decision clearly should not be unilateral. As several departments and employees will be involved with the idea and their cooperation will be required to develop efficient procedures, their opinions should be requested before any definite decision is made.

Develop working procedures and standards clearly:

If many users are involved, it will create confusion when someone has to work on another person's job file. Don't hesitate to ask your dealer or VAR for assistance if you need it.

The ability of the schematic entry software to understand electrical connectivity is essential for subsequent CAE and CAD tasks, such as simulation and PCB routing operations. Unlike a graphical editor, the schematic entry software understands that connections must begin and end on terminals or existing connections.

Understanding, selecting and using the tools correctly are the keys to successful autorouting. Nevertheless, many CAD users have been frustrated by mediocre autorouting results. There are four main reasons why this happens:

- Your board designs are not suitable for autorouting;
- You have selected an autorouter that

RCS Cadcentres is one of Australia's leading PCB design service bureaus, with experience in fine line multilayer board design, documentation and artwork generation. These articles are adapted from a paper presented by Ray Smith to the CIMA seminars on PCB Manufacture, in March 1990.

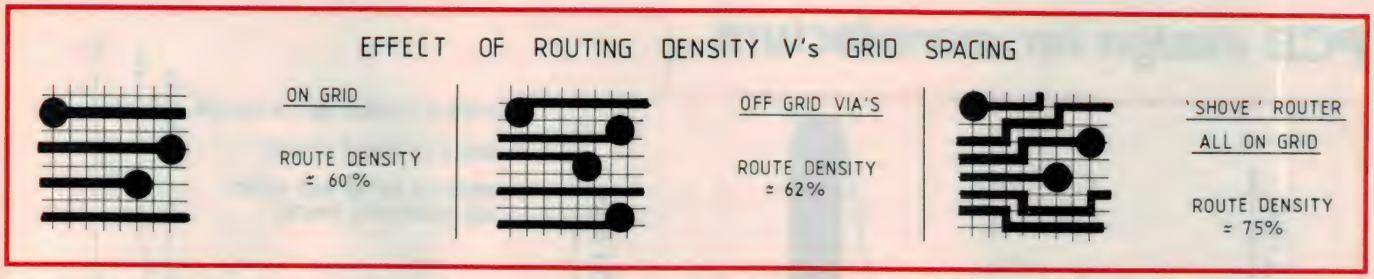

Fig.1: The effects of grid spacing and router rules on track density. On-grid routing provides a density of around 60%, while off-grid vias allow a small improvement. But on-grid 'shove' routing can achieve 75%.

is not appropriate for your design work;
- You have unrealistic expectations from your autorouter;
- You are not using your newly-purchased autorouter correctly.

Every autorouter is designed to route certain types of circuit boards. 'Smart' rip-up autorouters are generally less restrictive in the boards they will route, while 'dumb' heuristic/pattern and channel autorouters are usually very limited in the range of designs that can be routed. There are, however, certain types of designs which do not at all lend themselves to autorouting by general purpose autorouters. These include ECL designs, power supply boards, and designs using unusual technologies like flex and hybrid circuits.

If the autorouter is not designed and marketed specifically for these circuit types, it will not be able to handle them.

Even if your boards do not fall into this category, you may find that the routing results you are achieving are unacceptable. This could be because you are using the wrong autorouter. For example, if the boards you design are made up of 300 SMT devices, a $995 personal computer autorouter is simply not going to give you acceptable results.

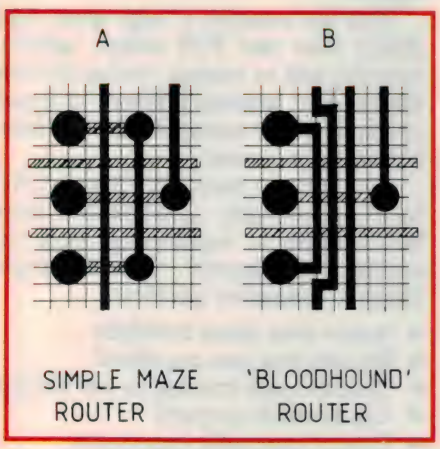

Fig.2: A 'bloodhound' router (B) can push existing tracks aside to fit new tracks, saving vias and space compared with a simple maze-type router (A).

A problem as common as choosing an inappropriate autorouter is that of setting unrealistic goals for your router's performance. Having a realistic expectation level can mean the difference between satisfaction and unhappiness. What can you reasonably expect and where can you anticipate problems?

Autorouting is an extremely complex mathematical problem. As the design density increases and the required completion percentage is higher, the amount of calculation required to autoroute the board can grow enormously. Generally, it will take modern rip-up autorouters longer to complete the final 1% of the connections than it did to complete the initial 99%. Also, the better the autorouter, the longer the routing time required. One or two days for a high-performance autorouter should be acceptable. This is still considerably faster than manual design, and requires no expensive design labour to produce.

You may well have purchased the right autorouter for your needs, but may still find that you have problems in getting good autorouting results. The reason could be that you are not using the autorouter correctly.

Common mistakes that we see from autorouter users include the following:

1. **Poorly selected pad, trace, routing grid and clearance rules.** These four design rules are extremely important for achieving good results and must be coordinated together. Choosing mismatched rules can easily make the design unroutable. Designers must decide on the trace size and minimum clearance requirements, and then determine the routing grid based on these guidelines. Pad size is equally important, and a certain amount of calculation is required to ensure that these traces can go between adjacent pins of ICs given the trace, clearance and grid sizes selected.
2. **Poor component placement.** You must be sure to place the components so that the component pins lie on the selected routing grids.
3. **Selecting the wrong routing direction for each layer of the design.** Virtually all autorouters are structured to route in a particular direction on each layer of the layout. Routers tend to be much more sensitive to this factor than a human designer, because it is more difficult for them to violate the layer rules.

Setting proper expectations is important. Few autorouters can produce design work as high in quality as an experienced designer, nor will they always achieve 100% completion.

If your problems are caused by not using the autorouter correctly, consult with the vendor for tips on how to use the router. You should prepare an autorouter checklist of the items that must be checked before starting the autorouter. You should run through the checklist every time you use the autorouter until it becomes second nature.

While conventional dual-in-line designs are often routable using gridded methods, more and more designs cannot be routed effectively without gridless techniques because of the fine-line routing required and the mixture of different component types. The case for gridless routing has now been proven in practice, and it will become more essential in the future.

All the major CAD vendors have produced their own automatic routers, and because of this, most benchmarks comparing different systems concentrate on routing results. If one automatic router completes the job while another fails, the order will go to the winner, with less consideration for the rest of the system. If neither or both complete the job, the other considerations become more important. If therefore pays large dividends to a vendor to have the superior router, and to the customer, who is the ultimate beneficiary of the competition.

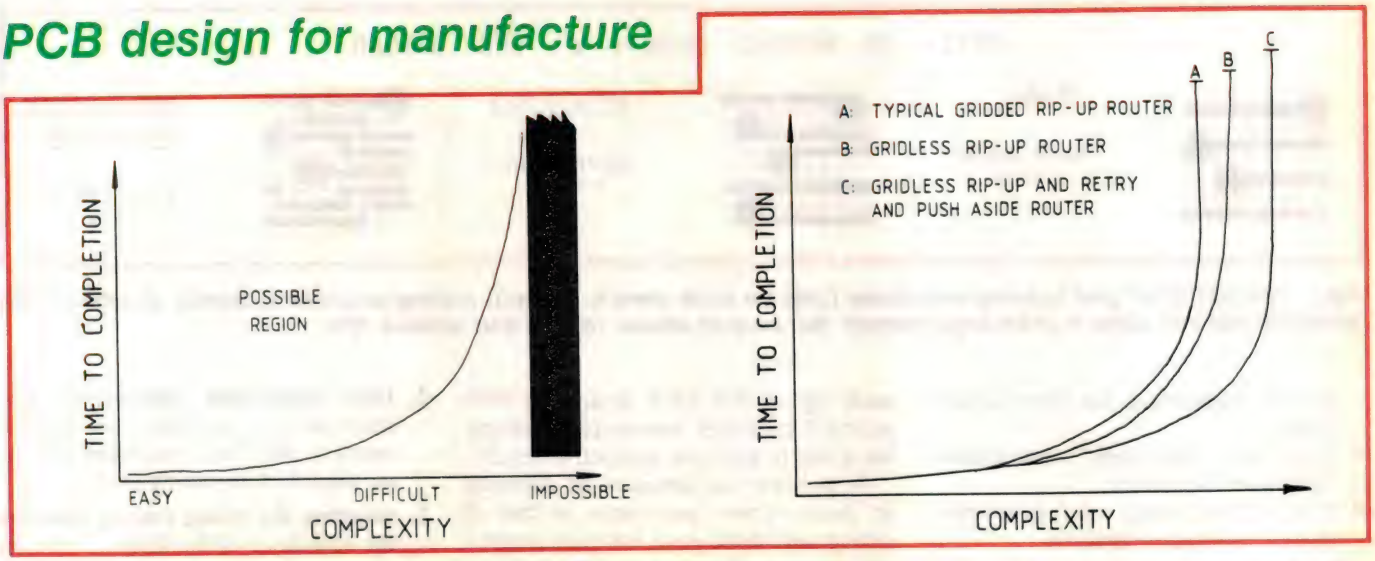

Fig.3: Time to complete routing grows exponentially as board complexity grows, and may become impossible. More sophisticated routers can also take longer, but completion is more likely.

It is perhaps not too surprising that as component sizes reduce, along with track widths, pad sizes and spacings, the board sizes do not. Instead, the number of components and connections increase. This causes the number of obstacles that have to be scanned in the internal data structures to increase, and therefore search times increase, too. With cell-based data structures the run times increase by at least a square law, as the grid size is reduced to allow for finer solutions.

The concept of complexity or difficulty of any given design has been touched upon in the past but, perhaps not discussed in depth. While no single measure of design complexity is definable, it is possible to state which parameters influence the routability for better or for worse.

For example, decreasing the board area while keeping the same relative placement and maintaining the same parameters will make routing progressively more difficult. This is normally measured as component density in terms of square inches per pad, or per equivalent number of dual-in-lines .

While this works well enough for boards with the same track widths and spacings and a similar mix of component types, it fails to take into account the number of routing layers and component placements.

The major change in gridless routing has been the introduction of push-aside techniques. These have had a major effect in increasing the complexity value of routable designs, and hence producing 100% solutions on designs that were previously seen as impossible. This is largely achieved by improving the quality of the routing – packing routes together more effectively and reducing the number of vias used.

Push-aside methods were developed from the expert systems approach to automatic routing – that is, by watching manual designers work. Invariably a designer will move previously placed routes aside to make room for a subsequent one.

It follows that early routing is tentative in that it should not be considered fixed, but should be movable to allow subsequent routing to be done.

Rip-up and retry methods are one solution to the connection-ordering dilemma in that they allow early routing to be removed and retried later. Push aside techniques are more immediate and often less dramatic in their changes to the routing previously laid down, and produce neater solutions. It makes sense to use both methods – push-aside to produce better completion rates per pass, and rip-up and retry to converge to 100% completion over several passes.

The quality of the routing produced is as important as the completion rates. Push-aside methods produce better routing patterns than rip-up and retry alone, yielding more manufacturable boards.

With the inclusion of high-speed logic (HSL) rules into PCB design, auto-interactive aids to manual routing become increasingly necessary.When crosstalk calculations are included, the problems become even greater.

In summary then, PC based CAD tools can probably accommodate more than 80-85% of engineering needs for routing and layout. The important things to remember are these:

- Assess your needs truthfully
- Buy the best you can afford
- Take as much training as you can get
- Use the tools properly
- Have a reasonable expectation
- Be prepared to adapt your designs.

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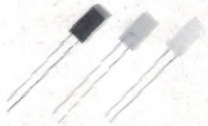

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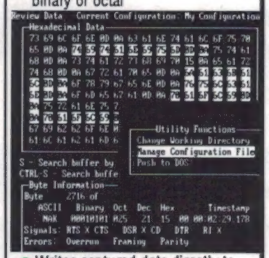

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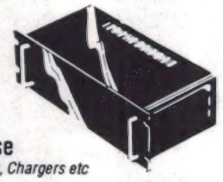

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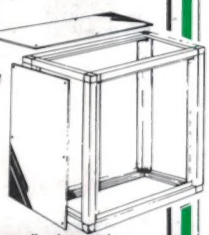

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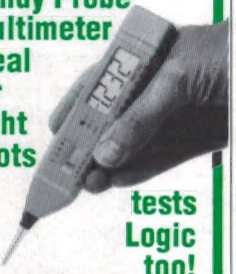
Handy Probe Multimeter Ideal for tight spots



tests Logic too!

No need to turn your head to read this multimeter. The readout is right there in the probe! Auto and manual ranging, 3.5 digit large 14mm LCD display - all in a handy probe. Logic testing function for CMOS/TTL. Data Hold button, Diode test, Continuity buzzer. Display shows all functions. Protected to 250V

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- AC Voltage from 2V to 500V
- Resistance from 200Ω to 20MΩ
- AC/DC Current to 200mA
- Continuity check to 2kΩ
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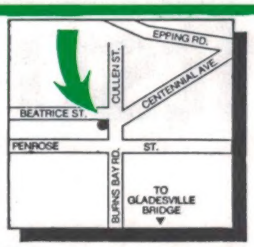

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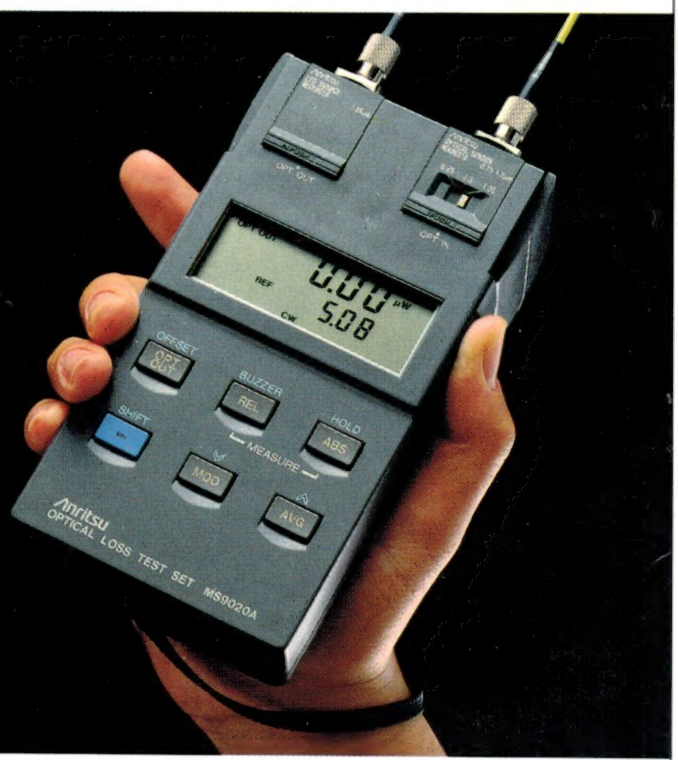
For simple power measurements, Anritsu also offers the compact ML9002A to cover the wide range from −70 to +3dBm.

Anritsu helps you go compact, without losing accuracy.

OPTICAL LOSS TEST MS9020A



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